POWER PLANT ENGINEERING

GENERATION - TRANSMISSION - DISTRIBUTION - UTILIZATION

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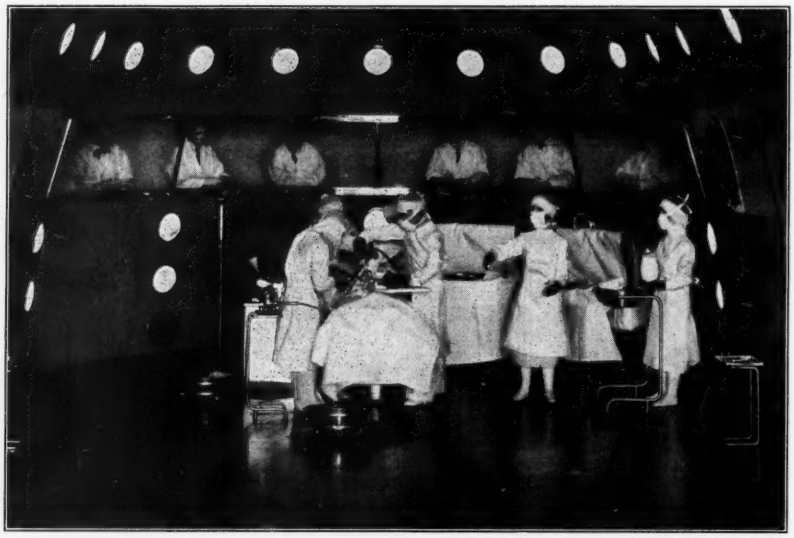
"Speaking of Operations"—



WITH DUE APOLOGIES to Irvin Cobb, we have heard many delightful accounts of all sorts of "ectomies" from proud victims of all ages. Cases of one, two and, if we remember correctly, even three hours on the operating table have been described with pride and enthusiasm while the proponents of "locals" vs. "generals" have argued the relative merits of their anaesthetic philosophies with such fervor and delight that often we almost decided to take the next ambulance to the hospital. But in all that vast fraternity of the "Order of the Operating Table" we venture to say that there is not one—not a single one—who could hold a candle to the distinguished victim shown in the photograph above. For he, or maybe it is a "she," holds the world's record for time, length of incision, number of stitches, frequency, power factor or what have you, for this operation lasted five months!

Now don't tell us we're all haywire—that it isn't so, that such a thing is impossible, for the chances are we would have to admit it. Yet there is an element of truth in our assertion. You see, this is only another example of things being not what they seem. This is not a real operating room, only a tiny model which formed part of the "Electrical Industry" exhibit at the Chicago World's Fair.

So much for that. We are less interested in the operating room of a hospital than in the generation of steam and electricity for use in hospitals. And so, speaking of operations, we would like to direct your attention to the expected operating costs of the new Longview Hospital described in this issue. The replacement of three old coal fired plants and two generating stations together with purchased power, by a single new steam electric generating plant will effect an annual saving of over $42,000 on a total former operating cost of $66,956. This is what we call a "successful operation." It is another excellent example of what modernization can do today. There are hundreds of plants throughout the country where the replacement of old equipment by new would effect similar savings.

Buzzard Point. A new central station these days is quite an event, it isn't done as often as it used to be. Perhaps it is just as well—we probably appreciate the ones that are built a little more. This year, outside of the Schenectady Mercury Vapor plant, the Buzzard Point Station of the Potomac Electric Power Co. is the only one to be started. It has a number of very interesting features and with merely a simple regenerative cycle, without reheating of steam, a station heat rate of about 12,200 B.t.u. is expected. At that, however, it has some fancy gadgets, such as a steam deheater between superheater sections, electrostatic precipitators, oil pressure piping inside the return lines and other classy features which a station in the Nation's capitol should have. The only thing we don't like about the station is its name—Eagles' Rest in our opinion would be more appropriate.

In New Jersey, this year, two very fine industrial plants were built, both for the Forstmann Woolen Co. Julius Forstmann, president of the Forstmann Woolen Co. is an extreme advocate of quality—quality in woolens, in power plants or what have you. During the war he told the government that its specifications for uniforms were poor. So he was asked to write new ones, which were duly accepted and after the war his company received the Distinguished Service Certificate. Apparently Mr. Forstmann's ideas regarding quality haven't changed much since then for last year when he decided to build a couple of new power plants, he got his engineers to design two industrial power plants that rival any central station in both design and equipment. In this issue we present details of these plants, one of which is in Garfield and the other in Passaic.

"The Anchor Windlass has been inspected and is secure, Sir." This is usually the way one reports to the captain aboard ship after making certain required inspections. This happens to be the anchor windlass. On Mondays, Wednesdays and Fridays you would report on the inspection of the davits or the steering engine. From an engineer's point of view, there is probably no greater farce on shipboard than this "cut and dried" method of making periodic inspections. In the operation of a power plant what we are interested in is not the instantaneous condition of a piece of equipment, but what the effect of its continued operation is—whether it is building up a condition that eventually may cause trouble. This is the sort of thing Mr. Smith discusses in his article on upkeep of electric motors in this issue. Most troubles on electrical equipment are caused by conditions that are cumulative. This article tells how to recognize these conditions and what to do when you find them.

WITH THE EDITORS

Announcement of December and January Issues

ENGINEERING PROGRESS is the crystallization of ideas into physical form for the accomplishment of service to mankind. Two factors are essential, first, new ideas, and second, physical means for working them out. Nobody who has studied the situation can deny that we have made definite progress in power plant engineering during the past few years despite the economic stress through which industry has been passing. It is only in volume of new work and improvements that our progress has been lacking. Ideas have been plentiful, pioneering has developed many of these ideas into practical form; advancements have been made in the efficient and reliable use of equipment; field experimental and investigation work has been carried out in many power plants; and pure science offers many opportunities for further advancement in engineering.

Careful study of its entire field and the service this magazine can render to its readers has resulted in a decision to devote the major portion of its December issue to a review of the achievements materialized during the past year and in the January 1934 issue a comprehensive treatment of modern boilers and combustion equipment will be given. While these two issues will be independent of each other in treatment, both are being prepared with the intent of giving greatest service to engineers faced with the problem of modernization.

In plant construction work, very little has been done during the past year, but certain classes of equipment have undergone marked improvement; a number of important engineering investigations have been reported in definite findings; the National Recovery Administration program and the public works construction planned by government officials are influencing greatly the type of plant construction which is about to take place; a new relationship between industrial and central station plants is taking place; research in the power plant field is taking a form in which every plant can contribute valuable data. These are a few of the topics that will receive treatment in the December issue.

Turning to a more specialized subject for the January issue, boilers and combustion equipment for the modern power plant will be covered in a way to aid the engineer in selecting, installing, operating and maintaining this class of equipment to give highest economy to the plant. Engineering data will therefore be given on boilers, economizers, superheaters, air preheaters, furnaces, stokers, pulverized fuel equipment, oil and gas burners, putting into the hands of the reader the latest available information which will be useful to the power plant engineer.

Reading the signs of the times, one is impressed with the certainty of a change in the economic order of industrial undertakings and with these changes will come a demand for cheaper and more reliable power. These issues will contribute helpful information in this direction.

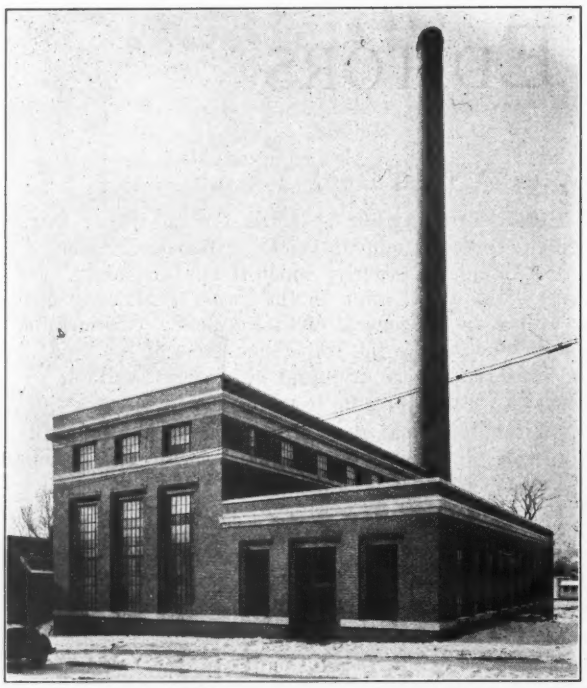
Concentrated Heat

FROM THE Arthur D. Little laboratories in Cambridge comes the announcement of the development of a new liquid heat carrier which it appears might have considerable application in the power generating field as well as in the general industrial field. This medium which is known by the ambiguous name of NS fluid, is an improved, inorganic liquid heat carrier suitable for use with temperatures up to more than 1500 deg. F.

Without a great deal of imagination it is readily apparent that such a liquid might be of considerable use in the transfer of heat from one place to another. Water can be kept from vaporizing only up to 706 deg. F. and then only by tremendous pressure. Diphenyl, used as a heat transfer medium between the hot flue gases and the air preheater in the boiler room at Bremo Station, is not considered useful above 900 deg. F. In contrast to these it appears that the use of NS fluid will be limited only by the durability of the materials in which it is enclosed at high temperatures.

This medium is a mixture of univalent and trivalent metallic chlorine salts, such as one mol of sodium chloride and one mol of anhydrous aluminum chloride. It is reported to have exceptional heat capacity, to be noncorrosive to iron or ordinary metals, to withstand decomposition in a closed system and to be available at low cost. It solidifies to a homogenous mass at 302 deg. F. but remains soft down to considerably lower temperatures. Above its melting point it is said to be as fluid as water.

Aside from its immediate application in such heat transfer schemes as in the air preheater system at Bremo, such a fluid might have many other applications in the power plant. Suppose for example (we are letting our imagination run) we had a power plant where each turbine unit had its own boiler built as an integral part of the unit itself with practically no high pressure piping. The steam in these boilers would be generated not by direct fuel firing but by coils through which high temperature NS fluid was circulated from a single central NS heater. Whether such an arrangement would be more economical or more practical than present arrangements of course is problematical but we submit it for consideration. It is one application that comes to mind. In another direction, the exceptional heat storing properties of this medium indicate its application in heat accumulators or regenerators for waste heat utilization. In the industrial heating field also it should have considerable application. Certainly this method of heating presents many advantages over direct firing methods. Whereas direct firing results in variable and irregular distribution of heat, a liquid medium such as NS fluid permits precise maintenance of a desired high temperature such as is otherwise available only by the relatively expensive use of electricity for heating. Whether or not any of these suggested applications are practicable remains to be seen but the reported properties of NS fluid certainly demand that its use be investigated.



New Plant A 42,000 D

MANY INEFFICIENT, obsolete power plants are still in service even though plans have been made to replace or rebuild them with modern equipment as soon as business conditions warrant. Many industrial companies justify this delay by saying that inasmuch as the plants are shut down or operating at fractional loads, burning little, if any, coal, a new plant would simply increase the capital expenditure with no immediate return. Institutional plants must, however, continue their service regardless of business conditions and old plants take their toll at a time when expenditures must be cut to the minimum.

This condition confronted the State of Ohio at the Longview Hospital (for mental defectives) at Cincinnati, O., and resulted in the construction of a new power plant which will replace three coal fired boiler plants, two generating stations and purchased power with a direct annual savings of something over $42,000 as shown by Table I.

Longview Hospital is under the Dept. of Public Welfare, John McSweeney, Director. The plant was designed and built by the Dept. of Public Works of the State of Ohio, T. S. Brindle, Director, John P. Schooley, State Architect. The construction was under the direct supervision in the field of H. T. Sutherland, State Supt. of Construction and it is to his intimate knowledge of operating conditions and requirements that the refinements of design, particularly the operating facilities, are due.

TABLE I. COMPARISON OF OLD AND NEW PLANT EXPENSES

Item—	Old Plants	New Plant
Coal	$33,250	$13,000
Gas	7,704	2,000
Electric Power	3,963	.....
Labor	17,040	7,740
Maintenance (Bd. and Rm. of Operators)	5,000	1,650
Total	$66,956	$24,390

The new plant with four 311-hp., 250-lb. W.S.P. Stirling boilers fired by Combustion Type E stokers and three Skinner Unaflow engine generator sets, is an excellent example of design and may well serve as a model for institutional plants or for industrial plants of 1000 kw. and under.

Not only is the design consistent with the service to be rendered but every operating and maintenance convenience has been provided at the minimum expense. Combustion control, soot blowers, meters and instruments, ladders, aisles and walkways make convenient and efficient operation possible.

After the plant was designed it became necessary to lower the expenditure temporarily, preferably without increasing the cost of operation. For instance, coal handling equipment and coal bunkers were left out at the last minute. Ordinarily this might be considered an ill advised movement but in this case it is a very logical one. Inmate labor is available for handling coal from the siding. The ash tunnel, steelwork and building walls were designed so that coal and ash handling machinery can be added later. The plant and tunnel will cost approximately $400,000 and the equipment in the power plant about $120,000 as shown by Table II, the basic contract costs for the equipment.

Boiler Room

Boilers are set in two batteries of two each with space provided for an additional battery as needed. Boilers are 250-lb. W.S.P., 311-hp. Stirlings set with the centerline of the mud drum 10 ft. above the boiler room floor and fired by 72-sq. ft. Type E stokers capable of firing the boilers continuously at 600 hp. or 750 hp. for 2 hr. Coal burned is crushed, run-of-mine, Ohio, averaging 12,000 B.t.u. per lb. as fired and costing $1.65 per t. delivered. Operating pressure is 200 lb. ga.

They are baffled for three passes with interlapped tile, the draft loss through the boiler being 0.14 in. at 100 per cent and 0.65 in. at 200 per cent load. Guaran-

TABLE II—BASIC CONTRACT COSTS FOR THE EQUIPMENT IN LONGVIEW HOSPITAL

Foundation	$ 1,940.00
Boiler	32,000.00
Stokers	20,250.00
Soot blowers	3,000.00
Brick work	13,750.00
Feedwater heater	2,320.00
Hot water heaters	1,640.00
Boiler feed pumps	1,950.00
Condensate pumps	1,450.00
Piping	19,100.00
Covering	2,600.00
Meters	3,929.00
Gage and thermometer	510.00
Zeolite softener	7,933.00
Hot process softener	6,947.00
Total	$120,063.00

t At Longview Hospital Saves 0 Dollars Annually

teed over-all efficiency of boiler and stoker at rated boiler load is 74.9 per cent and at 200 per cent rating, 73.1 per cent. Top of each setting and ends of drums are covered with 2 in. of 85 per cent magnesia, a ¼ in. coat of asbestos cement and a ¼ in. coat of asbestos and Portland cement.

Each boiler has an individual American forced draft fan rated at 13,500 c.f.m. of air at 4 in. W.G. and driven by a 15-hp., 220-v. motor. These fans are located on the main floor under the boiler as shown by Fig. 4, leaving the aisle behind the boiler clear. All motor controls are grouped on a panel in back of the boiler.

Feedwater heaters, hot process softener and two Dean Bros. 12 by 7 by 12-in. boiler-feed pumps are grouped at one end of the boiler room as shown by the drawing Fig. 5. All four boilers are served by a 200 ft. radial brick stack. The softener, a Cochrane hot process type, has a capacity of 6000 gal. per hr. The Cochrane deaerating heater, built for a maximum power of 10 lb. per sq. in., has a capacity of 9000 gal. per hr. of 150 deg. F. water heated to within 1 deg. F. of the saturation temperature of the exhaust steam. A vent condenser is provided and the heater guaranteed to maintain the oxygen content less than 0.025 cc. per liter.

The Hagan combustion control system consists of a master regulator, four balanced float controllers and a large dial operation indicator. The master regulator operates in accordance with steam pressure variations and controls the position of the boiler outlet dampers and the stoker control valves so that changes in air and fuel are in accordance with load changes. Each furnace is equipped with a balanced float controller, maintaining constant predetermined overfire draft by means of fan outlet damper adjustment.

The large dial operation indicator, readily visible from the firing aisle, as shown at the right of Fig. 2, serves to indicate the total load on the plant and guides the operator toward the correct functioning of the steam generating equipment. The equipment is operated by compressed air supplied by a small motor driven compressor with automatic control.

Engine Room

The three engines are Skinner horizontal Universal Unaflows, of the small clearance type and equipped with auxiliary exhaust valves, to secure maximum steam economy with the 200-lb. pressure saturated steam and 1 to 5-lb. back pressure.

The two large engines operate at 200 r.p.m. and have cylinders 18½-in. bore by 21-in. stroke, with pistons of the floating type, the piston rods being extended through back cylinder heads where a tailrod crosshead and guide are provided. The small engine operates at 225 r.p.m. and has a cylinder 16½-in. bore by 20-in. stroke.

Direct connected to each engine is an Electric Machinery Mfg. Co. welded steel, revolving field, alternating current, 3-ph., 60-cycle, 2300-v. generator. The two larger are rated at 250 kv-a. and the small one at 187 kv-a. Each alternator is provided with an individual high speed exciter, with multiple V-belt drive from the engine shaft.

Engine foundations and boiler room design are worthy of exceptional note as both are entirely new and distinctive. Foundations for the three engines are built integral with a reinforced arched tunnel extending the entire length, through which the main exhaust header is suspended. Exhaust from each unit passes down through a succession of U-bends through connecting reinforced tunnels to this main header which serves the domestic hot water heater at one end and the feedwater heater at the other, each being protected by an oil separator.

FIG. 1. THREE SKINNER ENGINES ARE INSTALLED WITH SPACE AVAILABLE FOR A FOURTH UNIT

These engines are of the small clearance type and equipped with auxiliary exhaust valves to secure maximum steam economy with the 200 lb. saturated steam and 1-5 lb. back pressure available. Each engine is direct connected to a welded steel revolving field alternating current generator

FIG. 2. BOILER ROOM LOOKING TOWARD FEED PUMP

Coal handling equipment and bunkers were included in the design but had to be temporarily omitted due to lack of funds. Steel work is heavy enough to carry this extra load

This arrangement presents an unbroken floor in the engine room and an ingenious system of sound-proofing breaks up all vibration and reverberation, enabling the engines to operate practically in silence.

All Passages Unobstructed

All aisles and passages in the boiler room are free of obstruction of any kind. Pipes from soot blowers, blowoff and the like have been symmetrically bent in close to the boiler settings, passing into ducts beneath the floor. This method takes care of all expansion troubles and presents an efficient and pleasing appearance.

All tunnels through which pipes pass are large, roomy and well lighted making inspection and work easily handled.

Peak About 162 kw.

As generators are all wound for 2300 v., 230 v. auxiliary power for the plant is taken from a 100-kv-a. 3-ph. power transformer. A 7½-kv-a., single-phase, lighting transformer is also available. The switchboard, a 10 panel General Electric, is complete with General Electric instruments and synchronizing panel. The total connected load in the hospital is about 500-kw. and past records show a peak of about 162 kw. and an average monthly consumption of about 47,800 kw-hr.

Water Supply

Engines exhaust to a manifold which supplies both the feedwater heater and the hot water heaters for the institution. These two Sims heaters, located in the engine room as shown by Fig. 1, have a total capacity of 5000 gal. per hr., raised from 40 to 180 deg. F. Water for the heater is softened by an Elgin 3-unit Zeolite system with a capacity of 16,667 gal. per generation. Well water, which will be used, has a total alkalinity before treatment of 345 p.p.m., with 72 p.p.m. of incrusting solids and 0.4 p.p.m. of iron.

The maximum peak flow of hot water has been metered as 36,635 lb. per hr. and requires over 91 million pounds of steam a year. Exhaust steam from the engines is not sufficient to heat this water at all times and a reducing station has been provided reducing the 200 lb. to 75 and from 75 to 5 lb. At present the 125-lb. steam is distributed to the institution buildings through the tunnel, details of which are shown by Fig. 8. This tunnel, because

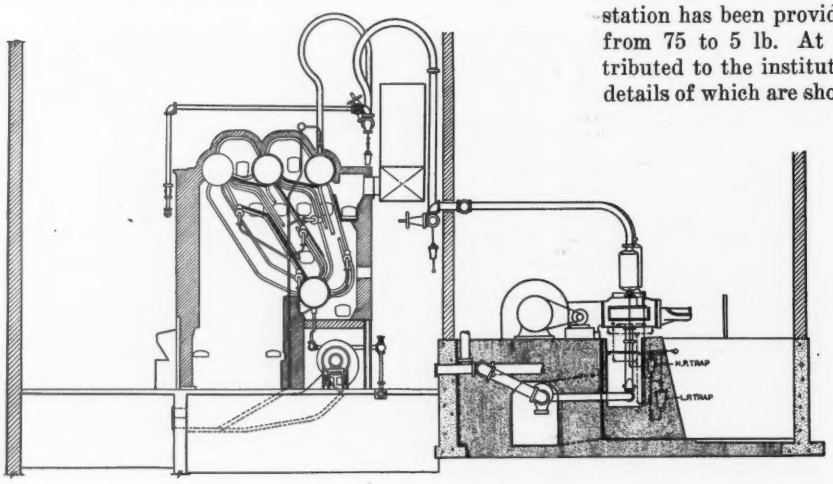


FIG. 3. CROSS SECTION OF THE STATION

Showing some details of the engine foundation

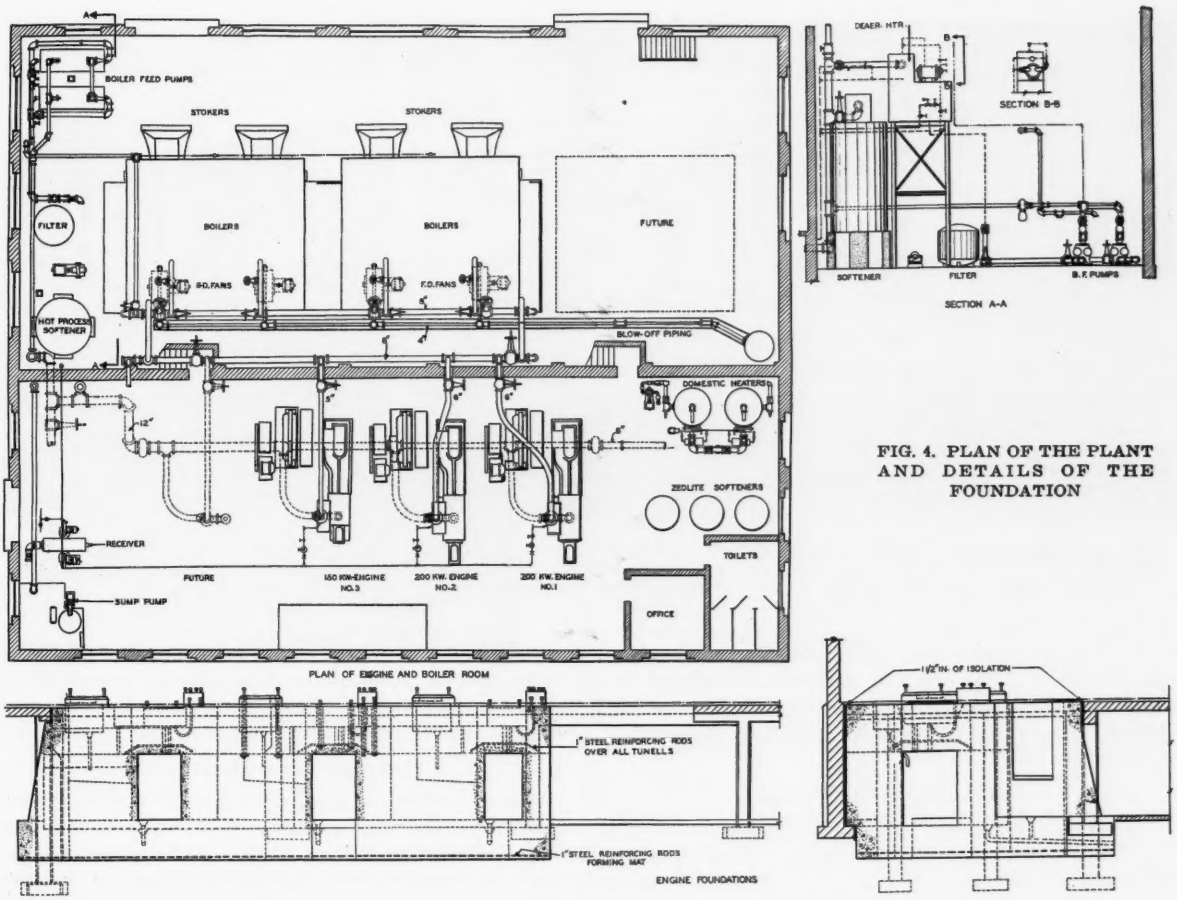


FIG. 4. PLAN OF THE PLANT AND DETAILS OF THE FOUNDATION

of its compact and ingenious method of changing the pipes from a horizontal to a vertical plane, is one of the interesting features of the development. Many of the details of the piping arrangement and supports are shown by Fig. 8. The new tunnel is connected to the old tunnel system, part of which is used as connecting passages between the buildings. It was this feature which made it necessary to change from a vertical to a horizontal pipe arrangement several times.

Wrought iron pipe was used for all cold and hot water

Principal Equipment in Longview Hospital Power Plant

Engines—Skinner Engine Co., two 18½ by 21-in., 317-indicated hp. Universal Unaflows operating at 200-lb. pressure with 5-lb. back pressure and driving at 200-r.p.m. Electric Machinery Mfg. Co., 250-kv-a., 200-kw., 2300-v., 3-ph., 60-cycle generators with an exciter driven through a Texrope drive.

Engines—Skinner Engine Co., one 16½ by 20-in., 239-indicated hp., Universal Unaflow operating at 200-lb. throttle pressure, 5-lb. back pressure and driving at 225 r.p.m., an Electric Machinery Mfg. Co., 187-kv-a., 150-kw., 2300-v., 3-ph., 60-cycle generator with an exciter driven through a Texrope drive.

Boilers — Babcock & Wilcox Co., four Stirling type, Class VII with total heating surface of 3112 sq. ft., made up of 301 3½-in. tubes and four 36-in. ID drums, fired by stokers.

Stokers — Combustion Engineering Co., Inc., Type E, steam driven, grate surface 72 sq. ft.

Boiler Feed Pumps—Dean Bros. Co., two 12 by 7 by 12 in., outside center packed, horizontal direct acting boiler feed pumps.

Forced Draft Fans — American Blower Corp., four fans with louvre type dampers, each fan with a capacity of 13,500 c.f.m. at 4 in. of water. Each driven by a 15-hp., 220-v., 1160-r.p.m. General Electric induction motor with push button control.

Feedwater Heater — Cochrane Corp. open deaerating type with vent condenser. Capacity 75,000 lb. per hr.

Feedwater Treatment — Cochrane Corp., hot process with pressure filter, capacity 4300 gal. per hr maximum.

Filter Pump — Union Steam Pump Co., single stage centrifugal, capacity 250 gal., 75 lb. pressure, driven by a General Electric 7½-hp. 220-v. induction motor at 1750 r.p.m.

Combustion Control—Hagan Corp. National Brake & Electric Co. compressor for operating air, driven by Westinghouse 3-hp., 1160-r.p.m., 3-hp. motor with pressure switch.

Hot Water Softener—Three Elgin Softener Co., Zeolite softeners with capacity of 6000 gal. per hr. each. System softens 50,000 gal. of 25 gr. water between regenerations.

Hot Water Heaters—The Sims Co., two, each with a capacity of 5000 gal. per hr. from 40 to 180 deg. F. when supplied with steam and at 5 lb. per sq. in. ga.

Hot Water Pump—Weinman Pump Mfg. Co., 2½ in. single stage centrifugal with capacity of 50 g.p.m. at 40-lb. pressure, driven by Imperial Electric Co. 1-hp.,220-v., 1750-r.p.m. motors.

Condensate Pump — Nash Engineering Co., capacity 22 g.p.m. against 8-lb. pressure. Driven at 3450 r.p.m. by Westinghouse motor with float control.

Switchboard—General Electric Co., 10 panel with General Electric instruments and synchronizing panel.

Transformers—General Electric Co., 3-ph., 100-kv-a. for power and 7½-kv-a., 1-ph. for lighting.

Atmospheric Relief Valves — Cochrane Corp.

Blow-off Valves—Yarnall-Waring Co.

Boiler Meters—Bailey Meter Co.

Chimney—American Chimney Corp., 200 ft. high, 6 ft. ID.

Feedwater Regulators—Northern Equipment Co.

Fireproof Doors—Steel Metal Products Co.

Fittings—Stockham Pipe & Fittings Co.; Walworth Co.

Gages—Consolidated Ashcroft Hancock Co.; U. S. Gauge Co.

Lubricators—Hills-McCanna Co.; Madison Kipp Corp.

Oil Separators—Warren Webster & Co.

Pipe—A. M. Byers Co.; Reading Iron Co.

Pipe Covering—The Philip Carey Co.

Pump Governors — Northern Equipment Co.

Reducing Valves — Illinois Engineering Co.

Safety Valves—Ashton Valve Co.

Soot Blowers—Diamond Power Specialty Corp.

Stop and Check Valves—Crane Co.

Sump Pumps—Nash Engineering Co.

Switches and Starters — Allen Bradley Co.; General Electric Co.; Trumbull Electric Mfg. Co.; Westinghouse Elec. & Mfg. Co.

Thermometers—The Bristol Co.

Traps—Armstrong Machine Works; Warren Webster & Co.

Valves—Crane Co.; Jarecki Mfg. Co.; Lunkenheimer Co.; Wm. Powell Co.; Star Brass Mfg. Co.

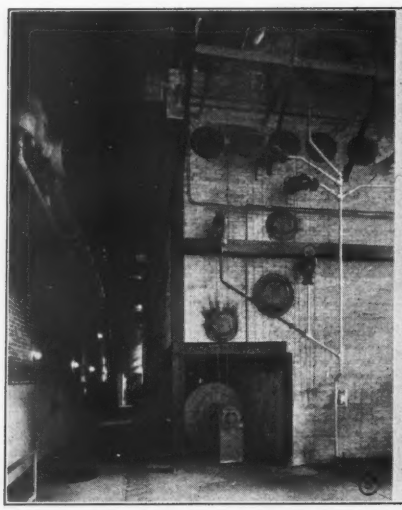


FIG. 5. THE AISLE BEHIND THE BOILERS HAS BEEN KEPT CLEAR OF ALL PIPES AND CONDUITS

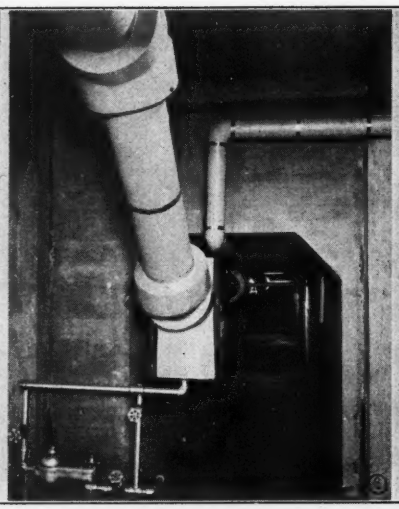


FIG. 6. A TUNNEL WITH THE MAIN EXHAUST HEADER RUNS THROUGH THE ENGINE FOUNDATION

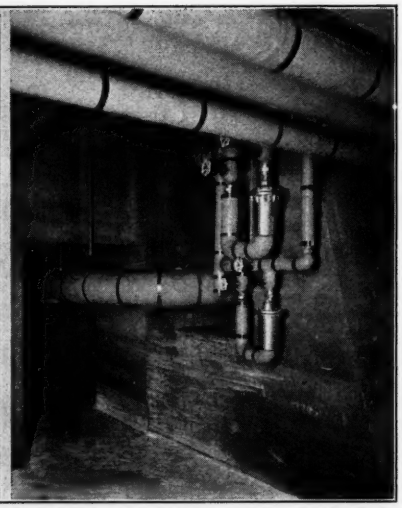


FIG. 7. THERE IS A BRANCH TUNNEL AT EACH ENGINE FOR EXHAUST AND DRAIN LINES

lines. Hot water lines are covered with 2 in. and return lines with 1 in. of 85 per cent magnesia, both being finished with 6-oz. canvas duck painted with one coat of sizing and two of oil paint. All valves 2 in. and smaller are of brass.

Foundations and Floors

Concrete for general use, foundations and footings was 1:2:4 mix except for the stack foundation which was 1:2.5:4.5. Brick and terra cotta were laid up in Portland cement mortar, one part cement and three parts sand. Exterior surfaces of exterior foundation walls below grade were given two coats of emulsified asphalt, exposed surface, walls, risers and beams were hand rubbed to give a smooth surface. Floors were finished integral except in the engine room and office where a separate 1½-in. cement finish was used.

Erection and Supervision

One other feature about provision for operation warrants more than usual interest. Manufacturers of major equipment such as stokers, engines and combustion control, were required to send a capable operating engineer to the plant for periods of from 4 to 7 days in order to adjust equipment and instruct the plant personnel in its operation and maintenance.

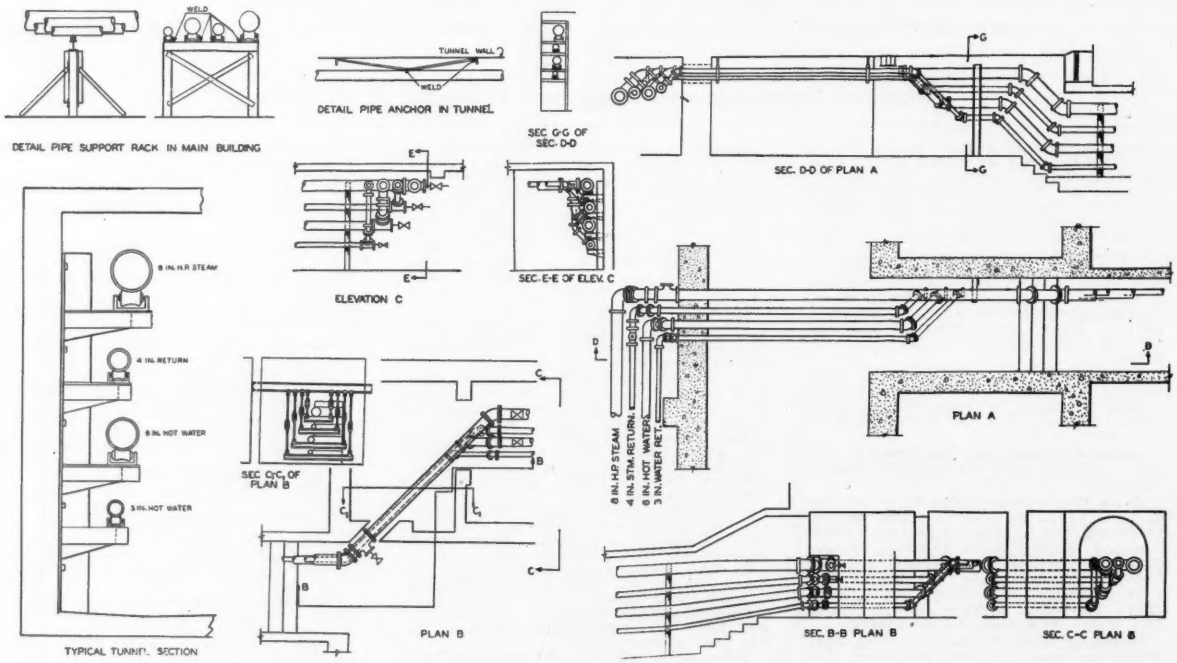
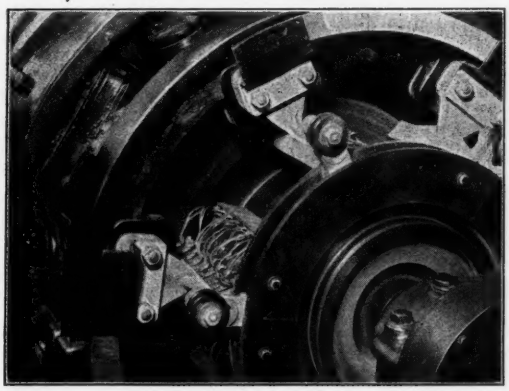


FIG. 8. DETAILS OF THE PIPE ARRANGEMENT AND SUPPORTS IN THE TUNNEL

Upkeep of Electric Motors *and* Generators



By FRANK V. SMITH
Federal and Marine Dept.
General Electric Co.

THERE IS PROBABLY no greater farce on shipboard from an engineer's point of view than that of making periodic inspections; say making the rounds of certain apparatus on Mondays, Wednesdays and Fridays, and others on Tuesdays, Thursdays and Saturdays and then reporting to the captain in this fashion "The anchor windlass has been inspected and is secure, Sir."

What an engineer, whether on shipboard or in a stationary power plant, is really interested in, is not a set of routine inspections but whether the equipment under his care is gradually building up a condition that will eventually spell trouble. In this regard nothing will take the place of common sense, good eyesight, good hearing and a good sense of smell. If the engineer has all these, and most engineers have, the thing he wants to know is, if he makes an inspection and finds things getting a little off color, just how he can bring an equipment back to its original condition so that it will be as good as new. That is, he wants to scent trouble before it happens, and never allow an equipment to run down at the heel to the point that it is a shore job to fix it.

Most troubles on electrical equipment are caused by conditions that are cumulative. A few years ago, ball bearing motors began to replace the sleeve bearing type with oil rings. The manufacturers in order to simplify things put alemite fittings on the bearings so that they could be filled with a pressure gun. The result was that in many cases, overzealous oilers who wanted to make their job a real job, used the gun once a watch and in a few weeks time had piled up enough grease on the floor to last a dozen motors for a year. Then there is the other extreme, that of a chief telling an oiler not to dare oil that motor (after 3-years running) as it was oiled when it left the factory. These conditions point out one thing and that is, some engineers need more knowledge and that others should exercise more vigilance. Now the facts about ball bearings are: that the ball races want to be packed only about ⅓ to ½ full for if they are packed too tight, they will run hot; another thing is that good grease ought to last from six months to a year. When grease has been in this long, it is likely to contain some of the wearings, and the ball races should, therefore, be cleaned and properly packed with new grease, being sure that in the process of cleaning and packing no foreign substances get mixed with the grease—this means grit off the hands or pieces of waste.

Troubles from Too Much Grease and Oil

Many ill results take place from too much grease; first, with a pressure gun it is possible to force grease out of the bearings along the shaft, and on to the commutator if it happens to be the commutator end bearing. A dirty, greasy commutator does not help the electrical end of the motor; and second, the grease may deposit on the windings and form the first sticky mess to catch dust and start building up accumulations on the insulation. From this point on, a lot of things can happen. The dielectric strength of the insulation may be affected, or the motor may run hot because the windings are blanketed and cannot get rid of their heat. These cumulative ills are generally what cause serious trouble in the end. It is perfectly obvious, however, that if the chief gave the oiler a good bawling out, the first time he saw grease on the floor plates or creeping along the shaft, all of the troubles to come could be averted.

Sleeve bearings, too, have caused their troubles, and more motors have been ruined by too much oil than with too little. Other troubles have resulted from not using care when drawing the oil and allowing gritty substance to get into it before applied.

If one takes a common sense view of motors there is not a great deal to do in their upkeep if they are given a fair chance. Cleanliness, a smooth running commutator and freedom from long sustained overloads that might cause overheating, are about all they ask. The life of a motor depends upon its insulation. Overheating causes certain elements in the insulating varnish to evaporate and this in turn makes it porous, allowing the absorption of moisture during periods of idleness. This is the reason for saying many times that a motor in idleness deteriorates more rapidly than one in use. If one keeps a motor clean and the insulation intact, no

one can tell its life. Records are on file where motors have run for 30 yr. and are still to all visual appearances, running as good today as they were when new.

Cleanliness and good insulation being the main factors in the life of a motor or generator, let's see what tools the engineer has at his disposal to check these items. Cleanliness, he can detect with his eyes—insulation resistance, with a megger. Assuming that he wants to get right on the job, let's consider what might be good advice, rather than the presentation of a stereotyped list of instructions.

First, one might say it is a good idea, when the machines are operating to keep one's eyes open to what is going on so as to prevent any troubles arising as denoted in the first part of the article; and second, when the units are shut down, to look things over to see that no oil, moisture nor dirt is collecting. This makes it doubly sure that the engineer not only knows what is going on but that he has a check on his observations, and if things are not as they should be, he can do something about it at the next opportunity for overhaul. Once, that he finds that the operating force has fallen in line with the finer points of operation, and that after months of operation everything appears as bright and clean as it was the first day the equipment went into service, he can afford to let down slightly and make his inspections a little less often. When a plant is new, a daily inspection might not be too often. After the operators have fallen into a routine, and the routine has been proved to be correct, an inspection every three months might be sufficient. It is a good thing to remember that more damage is generally done the first few months after a plant goes into commission, than the years that follow, unless the operating force is constantly changing.

The next advice in regard to the upkeep of motors and generators is what to do in case the equipments have accumulated dirt and oil on the windings, or if the insulation resistance by test is shown to be too low.

Cleaning Dirty Windings

In cleaning the windings, the approved practice is to use carbon-tetrachloride, a volatile, quickly evaporating solvent. Gasoline or benzine should never, under any circumstances, be used because of their explosive fumes, which become exceedingly dangerous in confined spaces.

The recommended practice is to apply the carbon-tetrachloride by means of compressed air under suitable pressure and to hold the atomizer close to the work so as to obtain the greatest benefit from the cleaning fluid. A small portable ventilating fan that will draw the fumes of the vaporized carbon-tetrachloride away from the workers should also be used. Compressed air should be used to blow any dust or foreign particles out of the windings.

In using carbon-tetrachloride, it is quite important to hold the spray close to the parts being cleaned as the more volatile contents of the fluid will be absorbed by the air, the heavier portions as sprayed on the windings not drying as quickly as might be expected.

If the windings are real dirty, it may be necessary to apply the carbon-tetrachloride spray two or three times. When this is found necessary, it is extremely important that the parts be wiped dry between each application by means of brushes, cleaning cloths, etc.

Sometimes, if the windings have been allowed to get into real bad shape, it even becomes necessary to use a hand scraper to get rid of the heavier incrustations. When this becomes necessary, use a wooden stick—never a metal scraper unless you want to help out the manufacturers by buying more windings.

After the windings have been thoroughly cleaned, be sure that all of the cleaning fluid has been wiped off and that none is trapped in the insulation. Carbon-tetrachloride being a solvent has a bad effect upon the insulation varnish, and may cause corrosive products, if ionization should occur in the vapor. Never try to varnish over undried carbon-tetrachloride, for if you do, the insulation will be softened.

After thoroughly cleaning and drying the windings, they may require varnishing, and they may not; this depends upon the state of the varnish film. If the high luster of the varnish film has been damaged or destroyed, so that there is a possibility of moisture absorption, then the insulation needs revarnishing.

Revarnishing

Revarnishing is not just anybody's job, and there are certain precautions that must be taken if one expects to get good results. One of the most important is to buy only the finest grade of varnish made expressly for the purpose. Find out from the manufacturer of the equipment what he recommends and do not be kidded into buying something just as good or better on hearsay. Most of the large electrical manufacturing concerns make their own varnishes and spend large sums on research yearly to improve their product. Varnish for insulations has to stand high temperatures and to be satisfactory must not evaporate out any of the binding elements over long years of service; should this evaporation take place, the varnish would become brittle, show cracks, and allow the insulation to absorb moisture.

Varnishes are generally applied in three coats, put on thinly, and allowed to thoroughly dry between coats. One of the first don'ts is, never put a coat of varnish on another that is wet; if you do, the under coat will remain gummy. Under certain high humidity or low temperature conditions, it may help to use a heater and electric fan combination, something similar to a hair dryer, to speed up the drying process.

Another important thing is to be sure that the windings are thoroughly dried out before the varnish is applied. Take insulation resistance measurements before the job of varnishing is tackled.

Some engineers prefer to spray air-drying varnishes on the windings. When using this method, it must be remembered that practically all quick-drying varnishes have a low flash point and, therefore, present a fire hazard unless extreme care is used. Ignition is readily caused by sparks, flame or excessive heating of any kind. This may result from short circuits or switching, or even from electrostatic discharges between the parts of the apparatus involved. To remove this latter risk, the metal parts of the spraying apparatus and machine being sprayed should be grounded to a common point.

In conclusion, it may be said that this cleaning and varnishing process looks like a big job. It is, and that

is why it pays to nip in the bud anything that is going to make such a procedure often necessary. With any kind of care, a motor or generator should run for three years without requiring a thorough cleaning and varnishing. When a motor gets plugged up with grease and dirt sooner than that, it shows that either the operating personnel have been letting things go, or that the improper kind of motor was installed (generally to save money). Engine rooms that are likely to contain heavy oil fumes, such as in Diesel engine plants, are no place for open, semi-enclosed, or enclosed ventilated motors, unless the proper kind of exhaust fans are provided in the engine room for keeping the fumes from entering the motor. Totally enclosed fan cooled motors in which the outside air is never circulated through the motor, are the only proper type, and they pay for themselves many times over if one takes into consideration operating expense and upkeep.

There is not very much more to say about what should be done to a motor on overhaul, except that when varnishing, one should not forget the commutator clamping ring insulation, and to see that all rusted iron parts are thoroughly cleaned and varnished. A cleaning and varnishing job once in 3 yr. is not so bad, and an engineer who can stave off the periods to that length of time will pass the test as a good operating engineer.

Killing Electrical Transmission Lines

Preventing accidents by guarding against the possibility of feed-back circuits.

By S. EIN

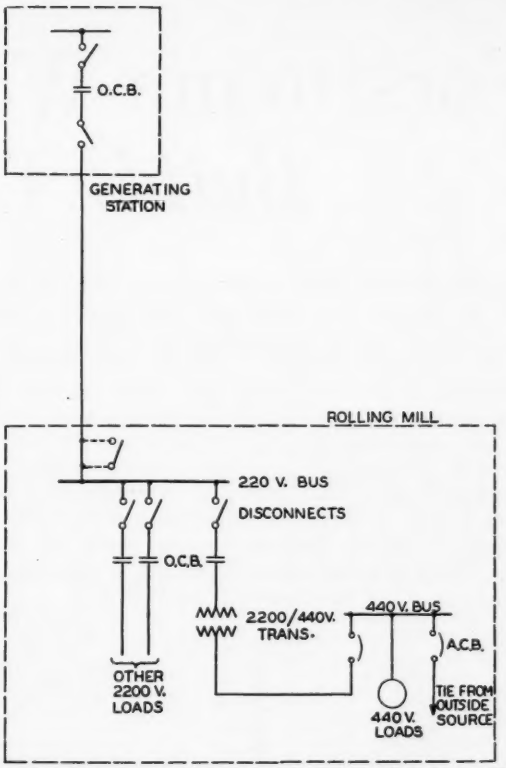
SAFETY IN COMPLETELY "killing" electrical transmission lines depends upon a full knowledge of every possibility by which they may be energized.

A fruitful source of trouble is a "feed-back" or sneak circuit. Such connections exist and must be guarded against.

In a large middle-western steel mill, one of the rolling mills receives power from a 2200-v. generating station, as shown in the accompanying diagram, over a single line. The feed is connected directly to the mill's bus without an intervening circuit-opening device, thus economizing on the number necessary.

From this bus, the 2200-v. loads receive power. Among them is a 2200 to 440-v. bank of transformers supplying power to the mill's auxiliary motors. For an outside source when this bank is not available due to repairs, maintenance and such causes, a tie line from another mill or substation is led in and connected to the 440-v. bus. The entire arrangement as pictured, from generating station to auxiliary load, is typical of many mills and is the most economical and dependable one.

When work is to be done on the 2200-v. line or bus, both must be, of course, de-energized. Preliminary to shutting down the equipment at the mill, the air circuit



PLAN SHOWING ELECTRICAL CONNECTIONS IN A STEEL MILL

breaker for the 440-v. tie is closed to keep power flowing to the mill's auxiliaries.

It is here that a source of possible accidents enters. If the disconnects and oil circuit breaker on the primary side of the transformers and the air circuit breaker on the secondary side are not opened, 440-v. power will be taken from the tie line and transformed up to 2200 volts The bus and tie line, presumably dead, will be energized and disastrous results will occur from the feed-back.

It seems impossible that anyone will fail to realize the situation as it exists but, due to complications of switching, a combination of circumstances or ignorance of the effect of leaving both sides of the transformer bank connected to their buses, the mistake can be made. This danger is one of the first items pointed out to the men killing lines or working on them and associated equipment.

Disconnects, shown by the dotted lines, have been installed in many mills to effectively kill the line at each end but, nevertheless, the bus can still be made alive as explained.

An accident due to the causes described has yet to occur in this steel mill, but the possibility is ever present and must be guarded against.

ANALYSIS of the electricity commissioners report for Great Britain for the year 1932 shows that the Clarence Dock Power Station of the Liverpool Corp. led all stations in thermal efficiency with a record figure of 24.72 per cent closely followed by the Deptford West Station of the London Power Co. with 24.55 per cent. That substantial progress has been made during the twelve months may be gathered from the fact that in 1931 Deptford West was at the head of the list with 24.02 per cent.

POWER PLANT ENGINEERING November 1933

Forstmann Woolen Co. *Builds* Two Modern Power P

DURING THE PAST year and a half, the Forstmann Woolen Co. of Passaic and Garfield, New Jersey, has been engaged in the construction of two new power plants to serve their mills at Passaic and Garfield, respectfully. These two plants which have recently been completed are of considerable interest not alone because of their unusually fine engineering design but also because of the economic principles involved in their construction during these years of depression. In many cases, a time of depression is a time to curtail any unnecessary expense. Few changes are made and equipment which is installed and operating is made to serve despite its often uneconomical condition.

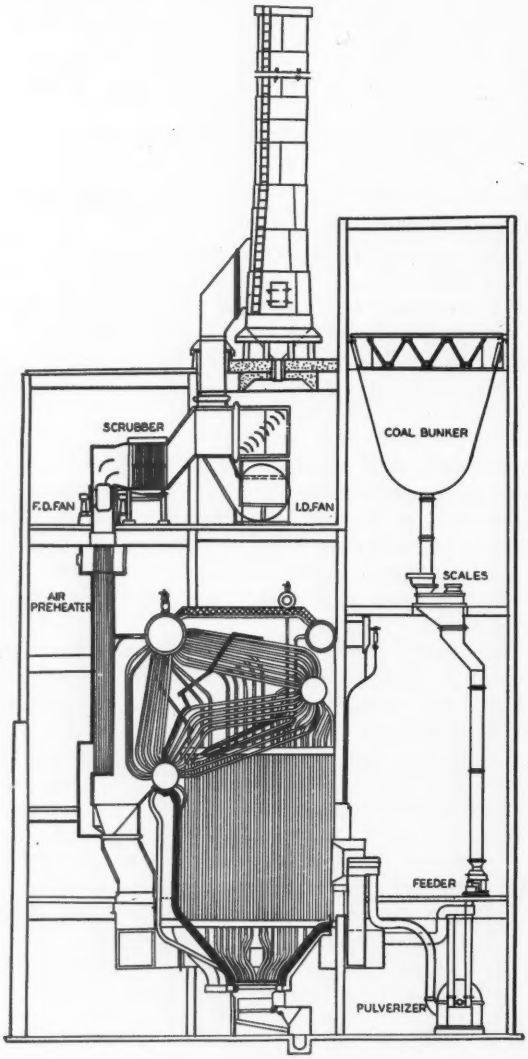


Fig. 1. Cross Section of Garfield Plant.

The mills of the Forstmann Woolen Company were already provided with power plants which had given service for years, and they might have served a little longer. The management, however, analyzed conditions and realized that by junking the old plants and building new power plants, the savings effected by the higher economy of the modern plants would pay good dividends on the investment involved, and so in February, 1932, orders for the new equipment were placed. Apparently, the owners are farsighted enough to realize that the money spent at a time when material and labor costs were unusually low was as good an investment as they could find anywhere. Also, the construction of these plants implies considerable faith on the part of the owners in the return of better economic and business conditions.

Design Resembles Central Station Practice

The two plants are very much alike, the boiler houses particularly being practically identical, except for size of equipment. In many ways they are more typical of central station practice than of industrial plant practice, though they were designed to meet the specific requirements of the textile mills they serve.

When they were first proposed, it was decided to build only new boiler plants, but after construction had been started it was decided to include new turbine rooms as well and so the plans were extended. In this article we present a brief description of the boiler plants, since these are perhaps of greatest interest.

Since the conditions at the two mills differed, the equipment is slightly different with respect to operating pressures and temperatures. At the Passaic plant, where three 60,000 lb. per hr. steam generating units are installed, the steam pressure used is 250 lb. gage and the total steam temperature is 506 deg. F. These steam generators consist of boilers with welded drums, superheaters, water cooled furnaces, air preheaters, steel clad insulated settings, pulverizers and gas scrubbers.

The Garfield plant is similar as regards equipment, but here, instead of three units of 60,000 lb. per hr., two units of 80,000 lb. per hr. are installed and steam is generated at 450 lb. pressure, 610 deg. F. At this plant steam is transmitted at 450 lb. to the mill where it is reduced for use at 110 lb.

Cross sections of these two boiler rooms are shown in the accompanying illustrations. As may be seen they are of the high vertical type used in recent years by a number of the newer central stations. The buildings are of brick and steel construction, well lighted on all sides by large steel windows set in metal sash. The arrangement of equipment is simple. The coal bunkers are placed high up in the boiler room, directly over the firing aisle, but so high as to not interfere in the slightest with the natural illumination. From the bunkers the coal is delivered by gravity directly into automatic coal

er Plants

scales and then to the feeders on the operating floor. Next it passes downward to the basement where the pulverizing mills are located. The furnaces are completely water cooled. Gases leave the boiler at the lower end at the rear and enter the air preheater, passing directly up through the latter to the flue gas scrubber to the induced draft fan and thence to the stacks. The stacks are of steel supported on the building steel. The flue gas scrubbers are compact affairs, consisting of a series of ribbed baffles located so as to cause the flue gases to impinge against them as they pass through the scrubber.

A thin film of water flows over the entire surface of these plates. The deflection of the gases by the staggered baffles produces eddies in the gas flow so that the mixture of gases and dust is scrubbed against the multiple films of water which trap and wash down the dust particles. In this way the gases are effectively cleaned of the greater portion of the suspended solids and also some of the soluble gases. The plates are of metal but are coated with a vitreous enamel which protects the metal from the corrosive action of the wet mixture. It is claimed that by the use of these scrubbers over 90 per cent of the fly ash is removed.

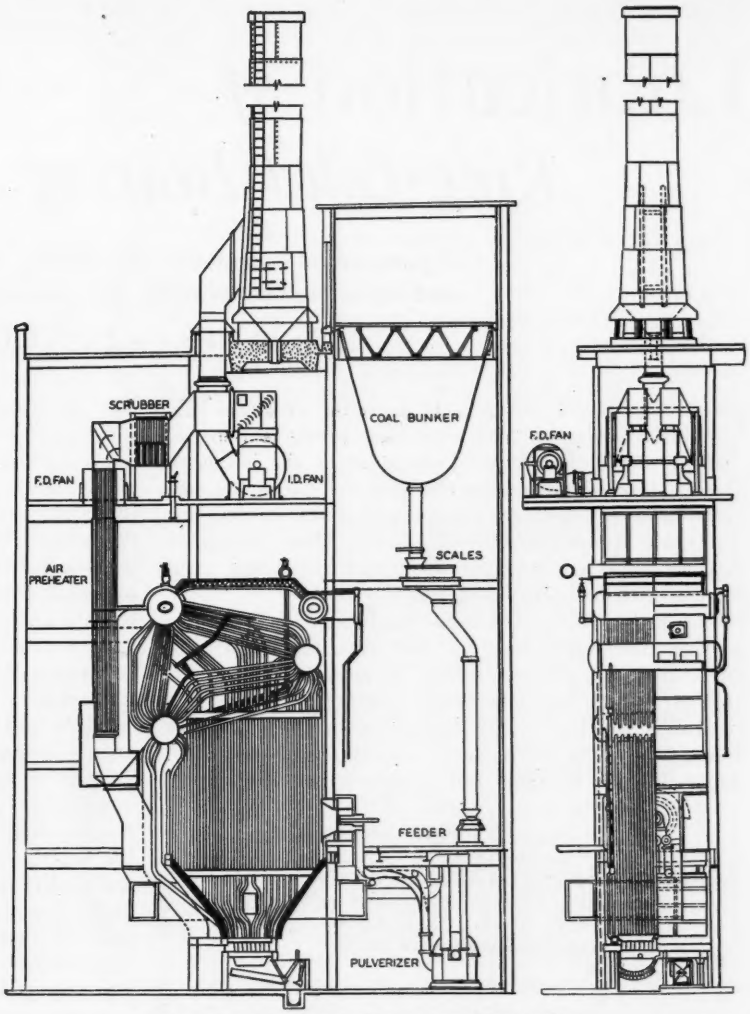


Fig. 2. Passaic Plant of Forstmann Woolen Co.

Both forced and induced draft fans are located on the upper floor of the boiler room.

Automatic control is used wherever possible. The plant is provided with an excellent array of instruments and meters and a full automatic combustion control system. Another detail in the construction of the plant which is of interest, is the method of applying the heat insulating material to the air preheater and gas passage ducts. This is not applied directly to the outside of the steel casing, but on an easily removable metal screenwork placed several inches away from the steel casing. Thus a dead air space is formed making an excellent heater insulator and making it possible to use a much thinner layer of insulating material.

It is too early to show any operating figures on these plants but the manufacturers engineering data may be of interest. At the Passaic plant where the three, 60,000 lb. per hr. units are installed the following conditions are expected to obtain:

Efficiency of a complete unit, 87 per cent at 30,000 lb., 86 per cent at 60,000 lb. Flue gas temperature leaving the boiler 585 deg. F. Flue gas temperature leaving air preheater, 350 deg. Air temperature entering air preheater, 70 deg. Air temperature leaving air preheater, 364 deg. Per cent CO_2 in flue gas, first pass 15 per cent. Draft loss through the boiler 4.0 in.

At this plant the heating surfaces are as follows: Boiler, 4590 sq. ft.; water walls, 2287 sq. ft.; air preheater, 5600 sq. ft.; furnace volume, 3150 cu. ft.

At the Garfield plant, the boilers are 80,000 lb. per hr. units. Here the expected efficiency is 86 per cent at 40,000 lb. and 83 per cent at 80,000 lb. The flue gas temperature leaving the boiler, 632 deg. Flue gas temperature leaving air preheater, 395 deg. Air temperature entering air preheater, 70 deg. Air temperature leaving air preheater, 368 deg. Per cent CO_2 in flue gas, first pass, 15 per cent. Draft loss through boiler and air preheater, 4.35 in. water.

Heating surfaces are, for boiler, 6520 sq. ft. For water walls, 2870 sq. ft. Air preheater, 6500 sq. ft. Furnace volume, 4500 cu. ft.

Steam from these plants is used both for the generation of electric power and for process work in the textile mills. The boiler plants have been in operation since the first part of this year but the turbine rooms have only recently been completed.

POWER PLANT ENGINEERING November 1933

Lubrication *of* *Ring-Oiled Bearing Steam Turbines*

Appreciable economies in power, replacement and maintenance possible by careful operation.

By JAMES I. CLOWER*

CONTINUOUS and reliable operation of steam turbines equipped with ring-oiled bearings depends largely upon the correct lubrication of the bearings. Correct lubrication implies not only the use of the correctly selected, properly refined oil for the service, but also upon the proper care of the oil. Many ring-oiled bearing units are required to operate for weeks, even months without being shutdown.

In order to render such continuous and reliable service, lubrication must not fail, even for a few minutes. If it did, the results may be most serious, resulting in scored and burned-out bearings, necessitating expensive repairs, but of greater importance would be the failure of the unit from the standpoint of reliability, especially if a stand-by unit were not provided.

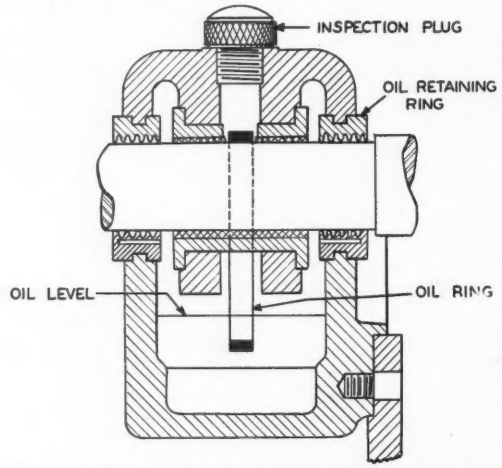


FIG. 1. TYPICAL RING OILED TURBINE BEARING
The ring rides freely on the journal and dips into oil contained in the reservoir. When the turbine is running, the ring turns with the journal automatically carrying oil to the top of the journal, whence it is distributed by the rotation of the journal and oil grooves cut into the babbit lining.

Lubricating oil selection for ring-oiled bearings of steam turbines is influenced by five major factors which tend to impair the lubricating value of the oil by subjecting it to severe duty conditions. These factors are: heat; water; solid impurities; air and constant re-use.

Heat

Ring-oiled steam turbines may be properly classified as high-speed machines. In general they operate from 1800 to 3600 r.p.m., and the peripheral velocity of the journal is in the neighborhood of 5000 to 6000 ft. per min. In consequence, considerable heat is generated by shearing the oil film which surrounds the journal. Assuming a 4-in. journal having a surface velocity of 6000 ft. per min. and surrounded by an oil film 0.003 in. thick, the rate of shearing the film would be 2,000,000 ft. per min. per in. of film thickness. Obviously this is quite a formidable rate of shear and as a result considerable heat is generated although the viscosity or body of the oil may not appear to be very large. Moreover, heat may flow from the steam through the casing and along the shaft to the bearings, thus augmenting that which is generated by the shearing of the oil film.

Referring to Fig. 1, it will be noted that the oil supply is contained, in this type of bearing, in a reservoir below the bearing. Because of the relatively small quantity of oil in use, and to the fact that the ring is not capable of flooding the bearing with oil, although the supply is ample for lubricating purposes, heat is not readily dissipated. Consequently, these bearings generally operate at a temperature somewhere between 140 and 180 deg. F. If, however, the unit utilizes superheated steam, or is located in a poorly ventilated place such as a basement, the operating temperature of the bearings may exceed 200 deg. F. On the other hand, if the unit is located in cool surroundings, or if cooling water is circulated through coils or cored passages in the oil reservoir as in Fig. 2, the operating temperature may be less than 140 deg. F. Such a low temperature is, however, rare.

Heat not only accelerates the chemical union of the oxygen of the air with certain hydrocarbons of the oil (called oxidation), but it also reduces oil viscosity or body, thereby decreasing the load carrying capacity of the oil film.

Thus, while the unit load imposed upon a ring-oiled turbine bearing is usually small, it is most essential that the oil possess sufficient viscosity at the operating temperature to float the journal within a complete oil film with a reasonable factor of safety against film rupture.

On the contrary, the oil viscosity should not be excessively heavy, because the fluid frictional power loss is directly proportional to the viscosity. If the oil selected has an unnecessarily heavy body at the operating temperature, the frictional loss will not only be excessive, but the bearing will operate at a higher temperature, thereby increasing the rate of oil oxidation. The oil selected should possess the requisite body to provide a factor of safety consistent with safe operation but not unreasonably high.

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Water is nearly always present in ring-oiled steam turbine bearings. It may be present in relatively large amounts, or, it may exist only in the form of moisture or vapor, the amount depending mainly upon the mechanical condition of the shaft-packing glands and the frequency with which it is withdrawn from the oil reservoirs. When installed, cooling coils or passages, of course, are another source from which water in the oil may originate.

A mechanical mixture of oil and water forms an emulsion which promotes sludge formations and accelerates oil oxidation, which in turn increases the persistency of the emulsion. Sludge and emulsion formations should obviously be prevented in so far as it is practical to do so, because of their natural tendencies to increase bearing temperatures, clog the oil grooves and decrease in general the lubricating value of the oil.

Solid impurities, which may be scale, iron oxides, core sand, dust and dirt from the air, are always present to a certain extent in the oil reservoirs. Such impurities increase the persistence of the emulsion and add to the quantity of sludge formed. Some of them, of course, may be of an abrasive nature and therefore score the journal and bearing.

Air

Air, of course, cannot be excluded from ring-oiled bearings. It comes in contact with the oil in the reservoirs and due to the churning action of the ring, it is intimately mixed with the hot oil. This thorough mixing of the air and oil in the presence of heat is very favorable to oil oxidation, which as has already been explained, promotes sludge and emulsion formations.

Constant re-use of the oil in the confined space of the oil reservoir is usually accompanied by a gradual accumulation of air, water and solid impurities in ever increasing proportions. Thus these impurities become thoroughly mixed with the constantly agitated hot oil.

From the foregoing discussion it is realized that the oil selected for ring-oiled turbine bearings should be of such a character as to offer maximum resistance to the detrimental influences of heat, water, solid impurities, air and constant re-use. In other words, the oil should possess to an unusual degree those properties which render it both chemically and mechanically stable. Experience has demonstrated that high-quality, pure mineral oils are best suited for lubricating ring-oiled bearings of steam turbines.

Oils Recommended

The accompanying table, based upon operating temperatures, gives the general specifications of oils well suited for lubricating ring-oiled bearings of steam turbines.

GENERAL SPECIFICATIONS FOR OILS SUITABLE FOR RING-OILED BEARING TURBINES

Operating Temperature Deg. F	Flash Point Deg. F	Fire Point Deg. F	Approximate ASTM Viscosity			Specific Gravity
			100	130	210	
Below 140	390	440	225	110	45	.88/.89
140 to 180	425	480	650	265	66	.90/.91
Above 180	500	550	1500	600	115	.90/.91

It is not claimed that these specifications are complete, as such values as neutralization number, carbon residue, tar tests, demulsibility tests, evaporation tests, and others are important also and have a marked influence upon the serviceability of an oil. The above values will, however, enable an operator to select an oil of the correct body, and if it is of high-quality satisfactory service will be realized, provided reasonable care is given it while in service.

Operating Notes

The main points to watch in regard to the operation of ring-oiled turbine bearings are:

Make certain that the proper oil level is maintained at all times. A sight-oil level gage is usually provided which indicates the correct oil level. If the level is permitted to fall too low, the bearing may be starved. If the level is carried too high, leakage from the ends of the bearing is likely to occur, and moreover, the rings may be prevented from turning at a sufficient rate to supply the required amount of oil.

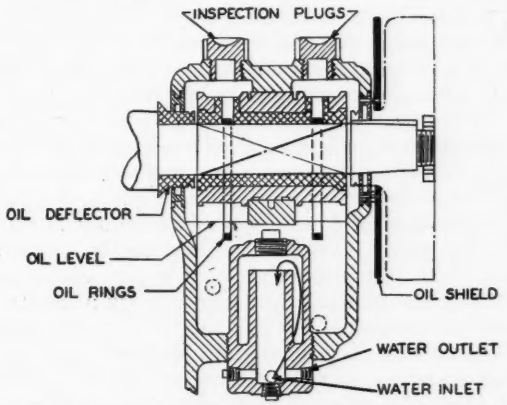


FIG. 2. WATER COOLED RING OILED BEARING

An occasional inspection should be made by removing the inspection plug to make sure that the rings are turning freely. A burr on the edge of the ring, or a flattening of the ring will often prevent the ring from turning.

Ring-oiled bearings should be periodically drained and flushed out. The flushing should be done with the same oil that is used for lubricating purposes. If of heavy body, a more thorough flushing will be attained if the oil is heated slightly. The oil drained out and that used for flushing purposes may be filtered and re-used.

It is most imperative, in order to obtain freedom from lubricating difficulties, to maintain the shaft-packing glands and oil-retaining rings in first class mechanical condition. If the shaft-packing glands are in poor condition, steam and water may follow along the shaft into the bearings where they mix with and contaminate the oil. Without a doubt much of the lubricating difficulties experienced with ring-oiled turbine bearings is due to faulty mechanical condition of the glands and oil-retaining rings.

Lubrication of ring-oiled bearing steam turbines is correct only when the oil films between the journals and bearings are readily formed and maintained. When such conditions exist, definite, appreciable economies are realized by reducing wear, and this in turn affects maintenance and replacement costs, reliability and continuity of operation.

Ash Handling Economy

An annual return of 23 per cent on investment in ash handling equipment is good business.

By

REGINALD TRAUTSCHOLD

WITH COMMENDABLE foresight, many concerns have been modernizing their plants in anticipation of keen business rivalry, as well as of the coming of better times. Expenses of every kind are being carefully scrutinized, especially burden expenses, i. e., expenses for operations that cannot be conducted so as to show a profit. Handling of ashes is a non-profitable expense for, while a good market may exist for clean, high-grade ashes, the best price obtainable is certainly never sufficient to justify the burning of coal simply for ash production. Handling ashes gives, therefore, excellent opportunity for effective and frequently quite substantial reduction in expense.

Use of modern materials-handling equipment is entailed, of course, but the net cost of handling must be such that the savings effected justify the investment involved. Selecting and operating equipment on a basis of final dollar economy is essential.

This is well brought out in the recent experience of a paper board mill in New Jersey, operating a steam plant of four boilers of 3741 hp. rated capacity, using buckwheat No. 3 as fuel and averaging 50 t. of ashes a day, about 15,000 t. during a year of normal operation.

A firm of consulting engineers was retained by the mill management to study the plant's requirements and determine the best possible result for outlay entailed. Several ways of handling the ashes involving investment cost of from $11,182 to $33,000 were considered, the net annual operating costs, based upon known average expenses in other installations, varying from $4577 to $6932. With requirements of 15,000 t. per annum, this gave the net ash handling costs per ton of ashes at from 30.4 to 46.2 cents respectively, automatically excluding some excellent methods of ash handling, on account of annual cost under the existing conditions.

Carefully compiled cost figures showed that the two methods entailing the smallest initial outlays were almost on a par so far as annual net operating expenses were concerned; one was industrial cars run directly under the ash hoppers to which the stokers discharge—rack operated gates and showers for quenching the ashes being provided—then pushed out to the dump; the other was similar in ash collection but had an overhead bunker tank to which a skip-hoist rig elevated the quenched ashes from the dump cars for temporary storage. Either of these simple methods gave promise of being satisfactory from an operating standpoint, the quenching of the ashes overcoming the dust nuisance that would otherwise be a consideration. The skip-hoist rig entailed an initial investment of $17,700 as against $11,182 for dump only, an additional outlay of $6518. Furthermore, the net annual operating cost of the cheaper ash cars to dump method could probably be held to about $68 less than for the skip-hoist method.

Figures of cost as given by Karl A. Leffren, Inc., were as follows:

Cost of Installation	Ash Car to Dump	Ash Car and Skip-hoist
Track cars and installation	$ 982.00	
With hopper and skip-hoist		$ 8,000.00
Concrete slab for ash dump	650.00	
Drain	50.00	
Foundation and pit		1,500.00
Electrical installation		200.00
Hoppers and gates	8,000.00	8,000.00
Cover for cars and tracks	1,500.00	
Total	$11,182.00	$17,700.00
Annual Operating Cost.		
Fixed charges	$1,677.30	$2,655.00
Labor	2,880.00	1,920.00
Power		50.00
Total	$4,557.30	$4,625.00

As a good and steady demand exists at the mill for the ashes, this really governed the final selection of the method and well justified the larger investment for skip-hoist rig and overhead storage tank. With the cheaper method, the purchaser of the ashes would have had to install some equipment for loading his trucks while, with the ashes placed in the overhead tank by the skip-hoist rig, the ash contractor can back his trucks under the tank and load by gravity. Providing this facility increased the price received for the ashes 10 cents a ton or $1500 a year, with the effect of reducing the ash handling burden some 33⅓ per cent. to 20.8 cents per ton. Expenditure of the extra $6518 for the skip-hoist plan brings in annual return of 23 per cent on this additional outlay, besides the savings that would accrue over ash handling by the shovel and barrow system.

Opportunities for improvements of this nature are to be found in nearly every industrial establishment, to cut burdens or non-profitable operations, selection of method and equipment should be on a basis of final dollar economy, considering all factors. The fact that at the paper board mill a better price was obtainable for ashes stored in an elevated tank than when dumped on the ground made the skip-hoist method the more attractive proposition. Had as little as 20 per cent greater ash tonnage been involved, a pneumatic conveyor system to an overhead storage tank would probably have proved a more economical method of ash disposal, while for a 25 per cent increase in the amount of ashes handled per year some method calling for heavier cash outlay, such as a continuous sluicing system of ash removal with a crane and overhead storage tank, might have done the work even more economically.

Sound financing calls for sound engineering, particularly in respect to non-profitable operations.

Commercial Aspects *of High Boiler Pressures*

Available data show that 2500-lb., 1000 deg. F. steam is probable economic limit under present conditions.

By A. G. CHRISTIE*

ENGINEERS have resorted to the use of high boiler pressures in an attempt to produce power at a lower total cost. This power production may occur in extraction turbines exhausting at vacuum to condensers, or, in bleeder or non-condensing turbines which receive the high pressure steam and exhaust into a main which serves a heating system or an industrial process. In the latter case, it is obvious that the higher the pressure, the greater will be the output of by-product power. This paper will discuss some of the commercial considerations involved in the use of high boiler pressures.

A factor in decreased costs of power is the better plant performance from coal pile to kilowatts that may result from the use of higher steam pressures. It is necessary to reheat the steam at one or more stages during its expansion when very high boiler pressures and moderate steam temperatures are used. This necessitates a form of boiler known as the reheater boiler where a large convection resuperheater is placed beyond a high pressure boiler and superheater. The boiler proper serves to absorb the radiant heat and reduce the flue gas temperature to the reheater.

Steam temperatures in this country were limited until recently to 750 deg. F. as this was about the safe limit for materials then available. With steels now at hand, however, this can be increased safely to 850 or 900 deg. F. While there is increasing evidence that 1000 deg. F. may be employed in the near future. The superheater now appears to be the limiting factor in the use of this temperature for its surfaces may be 100 to 200 deg. F. hotter than the steam inside the tube. At 1200 deg. F. steel is cherry red and oxidation takes place rapidly. New alloy steels will be available for use even under these conditions.

Increased Efficiency

Data upon the performance of several stations are available. The average annual station performance of Long Beach, California, plant for 1931 was 13,268 B.t.u. per kw-hr. at 86.13 per cent annual load factor with 410-lb., 750-deg. F. steam. The performance for Deepwater, N. J., Station for 1931 was 11,850 B.t.u. per kw-hr. at 87 per cent annual load factor with 1250-lb., 750-deg. F. steam and 75-deg. F. reheat. The gain of the 1250 lb. over the 400-lb. station is about 12 per cent. Further increase from 1250 to 2500 lb. per sq. in. at 750 deg. F. gives 3 per cent reduction in heat consumption with one reheat or 3.7 per cent reduction with two reheats. A change from 2500 to 3500 lb. per sq. in. gives no gain with two reheatings to 850 and 900 deg. F., respectively, and a further change to 5000 lb. per sq. in. shows a loss. With present temperature limits of steam, probably the most efficient and simple plant will be 2500 lb. per sq. in., 1000 deg. F., with 6 or 7 extraction points and no reheating.

A second factor is that of lower plant investment. Data in this connection are meager. Costs will also vary with the higher pressures, cycles of operation, and form of construction of the boilers. Engineers who have computed the relative costs of 400-lb. and 1200-lb. stations have stated varying figures for the cost of the higher pressure station. These range from equal costs to 15 per cent additional cost for the high pressure station or from $5 to $10 more per kilowatt. As boilers, valves, turbines, etc., are more fully developed and standardized for the higher steam pressures, the costs will closely approach those of the lower pressure plants.

High pressure boilers employing steam drums are necessarily expensive. These drums have in the past been made of hollow forgings. The forging after proper heat treatment is turned both inside and outside. These drums may be 4 to 5 in. thick resulting in great weight. Furthermore there is some question in regard to stresses due to temperature variations in such a thick wall. These high pressure drums are expensive. It has been proposed to build up these drums from rolled or pressed sheets by welding. Welding if properly inspected and tested is now allowed by the A. S. M. E. Boiler Code. Its use will tend to lower the cost of high pressure boiler drums and thereby substantially reduce the cost of high pressure power plants.

Drumless Boiler Designs

Other boiler designs do not employ a steam drum. These boilers are in general of the once-through or flash type. The feedwater is pumped directly into one end of the tubes and superheated steam is discharged at the outlet. These must necessarily cost less to build than those employing drums. Furthermore they should be safer as there is no large body of stored heat to cause extensive damage should rupture occur. The rupture of a single tube causes little damage. On the other hand, great dependence is placed upon the continued operation of the boiler feed pump, an interruption of which service is not permissible. Quite a number of these boilers are already in service and no serious difficulties appear to have developed. Foreign engineers appear to favor this type.

Another factor affecting the unit cost of 1250-lb. plant is the fact that a boiler of a given output in thou-

*Professor of Mechanical Engineering, The Johns Hopkins University, Baltimore, Md. From a paper presented before the Baltimore Section of the A.S.M.E.

sands of pounds, will develop a greater number of kilowatts than the same output would produce in a plant at lower pressure. Hence either smaller capacity and lower cost boilers may be employed, or else larger capacity turbines must be used for the same boiler output in pounds of steam as at low pressures.

Experience with high pressure stations has not indicated that these are any more liable to operating troubles than low pressure plants. As one engineer expressed it, the expected troubles did not occur but quite unexpected problems arose to require the attention of builders and operators. In the first place, the sulphate alkalinity ratio of the boiler feedwater must be maintained high in order to prevent caustic embrittlement in boiler parts. This high concentration of soluble salts in the boiler results in increased amounts of solids being carried over with the steam to the turbine. These solids are deposited on the intermediate stage blading and close up the passages thus decreasing the unit's output. A new technic for removing these soluble salts in service by washing with saturated steam, had to be developed. This practice is now general in high pressure plants.

Feedwater Requirements

It was early learned that boiler feedwater containing scale forming solids could not be permitted in boilers with pressures of 1200 lb. and over. The circulation in boilers with drums is moderate as compared to low pressure boilers for the steam bubbles formed in the boiler tubes are relatively much smaller due to the higher pressure, hence scale forms readily on the evaporating surfaces. At the higher rates of heat absorption now employed, these tubes burn out quite rapidly where scale is deposited, so only pure condensate and evaporated make-up can be used for feed in these boilers.

Possibilities of cheap power generation through the use of high boiler pressures and a reducing turbine are great. Fuel costs are relatively low, the fixed charges on the additional cost of the high pressure boiler and auxiliaries over that of the low pressure boiler and auxiliaries together with the cost of the turbine form the principal part of the total power cost. If the yearly use factor is high, these costs may be relatively small so that a supply of cheap power is the net result.

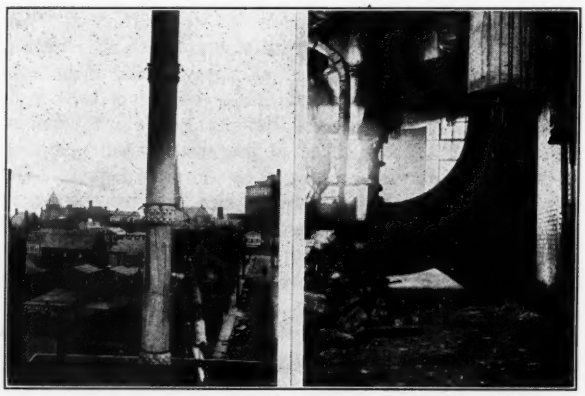
A number of years ago, engineers scoffed at the idea of 1200-lb. boiler pressure because no turbines or engines had been developed for such a high pressure. When the demand arose, satisfactory turbines were constructed for this and even higher pressures. There is no doubt that turbines for 2500 lb. steam pressure can be built when required. There is, however, some question about the advisability of constructing turbines for 3500 lb. and higher for the reason that the steam becomes very wet from a small degree of expansion when present superheat is used. Otherwise the steam must be reheated at several points in its expansion, this complicates operation and introduces pressure losses in the reheaters. When steam temperatures of 1000 deg. F. or higher are in use, higher boiler pressures than 2500 lb. may be warranted.

Feed pumps for use with these high pressures not only present problems in design but require considerable power for their operation. The pumps for very high pressures have generally been of the reciprocating plunger type which introduce packing problems of a serious nature. It would appear that pressures of 5000 lb. and over are of academic interest at the present time and will only be applied commercially where fuel costs are extraordinarily high or if a new cycle can be developed.

Certain economic considerations involved in the use of high boiler pressures have been outlined in the preceding discussion. One can conclude that the use of steam pressures up to 2500 lb. per sq. in. and 1000 deg. F. leads to increased thermal economy in the operation of power stations but above that pressure the probable economic results are not so well established. Since the total cost of a central station for 1200-lb. boiler pressure is very close to that of a 400-lb. station, the higher pressure plant will probably be adapted for more new stations to be constructed in the near future, particularly in those sections where fuel costs and use factors are high. Temperatures up to 1000 deg. F. may be used in such plants. Plants for still higher pressures than 1200 lb. are in service abroad and will no doubt be tried in this country, particularly for new base load units. High steam pressures are no longer the dream of the theorist but are available to any builder who has sufficient pioneering spirit to construct such plant.

New Stack Construction

AN INTERESTING DEVELOPMENT in stack construction was recently made by the Connecticut Power Co. at its New London gas plant. Exhaust gases from a gas generator are discharged at regular intervals through a waste heat boiler, the operation involving some vibration and at times gas explosions. These disturbances, together with corrosion, caused rapid deterioration of the former stack, the upper part of which had to be replaced twice in 6 yr.



VIEW OF THE CAST-IRON BASE AND THE SPLIT SLEEVE CONNECTIONS OF THE TRANSITE STACK

The new stack, 73 ft. high, is made of 30 in. Johns-Manville Transite pipe, the construction being evident from the photographs. The first 24 ft. from the base to the roof is Class A, 1.3 in. thick, and the remaining 47 ft. is class S, 0.67 in. thick. Connections are split sleeves fastened with special alloy bolts, the heads and nuts of which are covered with cement keyed over dished washers. The stack has not been in service long enough to determine whether bolt corrosion will take place or other troubles develop but to the present the stack has been highly successful and there is no reason to believe that the good record will not continue.

Inventory Records As a Means of Segregating Costs

Explanation of system applicable to factory equipment as well as to power plant.

By OTTOMAR H. HENSCHEL

DETERMINATION of segregated costs, including first costs, maintenance and repair charges of buildings and equipment, is as important in power generation (and purchase), power distribution and utilization and maintenance of equipment as in actual factory production. For without it, unit costs are not available and in their absence management is at a loss to know:

(A) Whether or not to purchase electrical energy requirements.

(B) Whether or not to continue generation of such electric energy requirements either wholly or in part as on some partial generation scheme.

(C) Whether or not to discontinue purchased electric energy requirements wholly or in part and to proceed to install local generating equipment.

(D) Just what unit, or units, in the plant may be costing in repair and maintenance more than would a new unit, or units.

(E) Whether belt, group or individual drives should be employed.

(F) Just where "leaks" may exist which otherwise might not be found and stopped.

The scheme advanced here for recording building and equipment costs will be found readily applicable for adoption throughout the institution.

Identification of Units

Modern trends demand the unquestioned detailed identification of each and every unit of consequence comprising the whole. Numbering is logically the physical means towards this end. So the various buildings of the manufacturing plant should be numbered and an individual record established and maintained for each. This record should indicate briefly the type of building, size, form of construction, original cost, adopted rate of depreciation, and should further provide space for monthly repair costs. It may well be termed an inventory or equipment record; for obvious reasons the loose leaf type is preferable.

Inventory Record

Figures 1 and 2 illustrate a type of inventory applicable to present day requirements. Let us assume that the case on hand applies to an industrial power plant, a steel and brick building approximately 100 by 75 ft. ground area and 22 ft. high, erected to have the following equipment: The original cost of the building with stack, transformer vaults, etc., exclusive of foundations, was $38,650. Housed in the building are:

4 200 rated horsepower, water-tube boilers equipped with underfeed stokers, steam-flow meters, draft gages, feed-water regulators, etc.
2 Boiler feed pumps.
1 Feedwater heater.
1 Vacuum pump.
2 125-kv-a. turbine generating sets.
1 14-8¾ by 10-in. air compressor operated by a 75-hp., 0.8-power factor synchronous motor.
1 450-kv-a., 13,200-v., primary, to 480/240-v., secondary, three-phase transformer.
1 60-kv-a. static condenser.

FORM M-1010 4-27 EFSCO. 5

INVENTORY RECORD—REAL ESTATE, BUILDING AND MACHINERY

Description Building - Power - Monitor type, steel - brick 100 by 75 by 22ft. ht. Our Machine No.

Maker's No. Made by

Purchased on From Building No. 2

Installed on 1927 By Keystone Construction Co. Power to Operate H. P.

Cost Price $ 38,650.00 Rate of Depreciation 2 Per cent. Transferred

Freight Installation Cost Cost Complete $ 38,650.00

YEAR	NET VALUE	COST OF ADDITIONS	DESCRIPTION OF ATTACHMENTS OR ADDITIONS	REPAIRS	DEPRECIATION	INVENTORIED AT
1927						
1928						
1929						
1930						

FIG. 1. INVENTORY, OR EQUIPMENT RECORD FORM APPLICABLE TO BOTH STRUCTURES AND MACHINES

REPAIRS

	1927	1928	1929	1930	1931
January		2 30		10 10	
February			1 60	3 89	
March				1 40	
April			10 12	70 21	
May				22 27	
June				1 10	
July					
August			1 40		
September				45 14	
October			3 04		
November				27 99	
December				36 61	
		2 30	16 16	218 71	

FIG. 2. UPON REVERSE SIDE OF FORM SHOWN IN FIG. 1 SPACE IS PROVIDED FOR MONTHLY REPAIR AND MAINTENANCE COST RECORDS

and, of course, all required auxiliary equipment such as coal bunkers, weigh larry, ash conveyor, piping, switchboards and wiring.

Upon completion of the building proper an inventory record sheet would then be inserted in the book provided for the purpose and proper entry of available data made.

Under description we might well include that information as indicated in Fig. 1. Obviously, however, such items as maker's number, machine number, power to operate, freight, etc., would not apply to a building. The column items are, of course, self-explanatory.

With the plant in question having been erected in, let us assume, the year 1927, any repairs made thereafter would be entered monthly on the reverse page form, Fig. 2.

Machinery Records

Machinery would be handled in a similar manner. In fact, the greatest value of the scheme proves to be in connection with machinery items primarily because these by their very nature are subjected not only to depreciation but also to obsolescence, wear and tear, factors not ordinarily chargeable to buildings to as great a degree.

Consideration can now be given to the boiler plant wherein each of the major units has been properly numbered and is of the bent water-tube type and equipped as explained above. The boiler with all of its fittings should rightfully be taken as a unit. Thus, with repairs to stoker of boiler No. 3, the cost of these is rightfully entered against this steam generating unit.

Figures 3 and 4 illustrate records of boiler No. 3 and will readily convey the working principle of the scheme.

Derivation of Costs

Prior to derivation of costs, it becomes imperative to establish a chart of accounts, one, however, capable of being coördinated with the general accounting system of the organization. This will, of course, then require no small degree of coöperation between operating and accounting departments. Hypothetically, we can set up such a chart and accept for purpose of example the account numbers and items as presented.

Account Numbers — Item-Repairs and Maintenance

1000....Buildings, chimney, foundations, fences, walks, yards, etc.
1001....Boilers, superheaters, economizers, stokers, furnaces, stoker blowers, feedwater regulators, CO_2, draft, and steam flow indicators, and recorders, etc., etc., and connections.
1002....Coal bunkers, weigh larries (or scales), coal and ash conveyors, ash receivers, etc., and connections.
1003....Boiler feed, vacuum, circulating and sump pumps, feedwater heaters, water meters, etc., and connections.
1004....Boiler room water piping.
1005....Boiler room high pressure steam piping.
1006....Boiler room low pressure steam piping.
1007....Air compressors, driving motors and controls, receivers, connections, etc.
1008....Turbine and engine generating units, condensers, exciters and connections.
1009....Switchboards, wiring, etc.
1010....Transformers, motor-generator sets, converters, lightning arrestors, etc., and connections.

FORM M-1019 4-27 EFSCO. 5

INVENTORY RECORD—REAL ESTATE, BUILDING AND MACHINERY

Description: Longitudinal Drum Water-Tube Boiler - 211 rated hp. Our Machine No. 3
Maker's No. 2371 — Made by: Standard Boiler Works
Purchased on: 2-8-27 — From: Standard Boiler Works — Building No. 2
Installed on: 4-15-27 — By: Ourselves — Power to Operate: H. P.
Cost Price: $4,870.00 — Rate of Depreciation: 5 Per cent — Transferred:
Freight: Allowed — Installation Cost: $7,233.41 — Cost Complete: $12,103.41

YEAR	NET VALUE	COST OF ADDITIONS	DESCRIPTION OF ATTACHMENTS OR ADDITIONS	REPAIRS	DEPRECIATION	INVENTORIED AT
1927						
1928						
1929						

FIG. 3. INVENTORY RECORD FOR WATER TUBE BOILER

1011....Static condensers and connections.
1012....Engine room high pressure steam piping.
1013....Engine room low pressure steam piping.
1014....Engine room water piping.
1015....Oils, lubricants.

REPAIRS

	1927	1928	1929	1930	1931
January			$ 94 33		
February				$10 10	
March		$ 12 10			
April			12 82		
May			13 14		
June					
July		2 05		62 30	
August				58 67	
September			6 02	13 02	
October					
November		106 10			
December	$ 4 51		70 17	2 10	
Total	$ 4.51	$120.25	$196.48	$146.19	

FIG. 4. REVERSE SIDE OF FIG. 3 INDICATING REPAIR AND MAINTENANCE COST RECORDS OF WATER TUBE BOILER

NON-PRODUCTIVE LABOR **JOB TICKET** CLOCK No. 829

DATE 4-16-30 DEPT. MAINT.

Occupation Steam Fitter

Description of Work Repack stop valve and adjust — Boiler No. 1

ACCOUNT NUMBERS 1001

TOOL NO.

MACH. OR PRESS NO. Boiler No. 1

BUILDING NO.

Total Tickets for Day 4

ARBITRARY DISTRIBUTION

ACCOUNT	PERCENT	AMOUNT
[redacted]		
[redacted]		

REMARKS

Hours	Rate	Amount	Total Hrs.	Total Amount	Total Amount All Tickets For Day
2½	.60	1.50	10	6.00	4
No. Pieces	Pc. Rate	Amount	Total Hrs.	Total Amount	

Stop 9:30 A.M

Start 7:[redacted] A.M

Elapsed 2 hr. 30 min.

FIG. 5. BY EMPLOYMENT OF THE JOB TICKET ACCURATE COST RECORDS ARE POSSIBLE

1016....Waste and supplies.
1017....Small tools.
1018....(A)....Chief engineer's salary.
(B)....Chief electrician's salary.
(C)....Assistant engineer's wages.
(D)....Assistant electrician's wages.
(E)....Firemen's wages.
(F)....Oilers' wages.
(G)....Miscellaneous wages.

Time Records

For successful operation of the scheme all number 1018 accounts should be made to cover operation only. Repairs and maintenance must be kept separate. For any work other than maintenance it is suggested that tickets as of the form illustrated in Fig. 5 be employed. Each man whether on a maintenance or repair job ought to be required to indicate in writing, as shown, the exact time (preferably in hours and tenths of an hour) just when a specific piece of work or job is started and also the exact time of completion of the job. These tickets may be issued by the chief engineer, one of his assistants, or a clerk in plants of such size as would warrant his employment.

In the case of operation, these naturally are to check in as such at the start of each shift with a similar check

MATERIAL REQUISITION (ON STOREROOM) No. 42448

ISSUE

TO [redacted] DEPT. 10-8-30 DATE

QUANTITY	DESCRIPTION	WEIGHT OR MEASURE	PRICE	PER	VALUE
(1)	Vat Heater. Code No. RC-1				
	RAW MATERIAL				
	GEN'L STORES				

SIGNED [redacted]

CHARGE a/c 1010 APPR. No.

CHARGE a/c PART No.

BLDG. No. MACH. No. RC-1

FIG. 6. MATERIAL REQUISITIONS SHOULD BE USED IN CONJUNCTION WITH JOB TICKETS

out at the end of the shift. It is of the utmost importance, however, that an operator, required to do any repair or maintenance work, change his operating ticket for one indicating the nature of the repair work, the number of the unit being worked upon, the correct charge account number and the lapsed time. In this manner it becomes possible to secure accurate segregation of operating and repair and maintenance costs and a record of the cost of repairs and maintenance of each unit or item.

Unless originally ordered for some specific machine, unit or building and that for immediate use, all repair parts whether being held in a regular store room or in the power plant proper should be first checked into stock.

Material Requisition

No material of any kind should be accessible to any repair man, whether he be an operator or a member of the repair and maintenance department unless and until he has had executed and authorized the withdrawal of such material, repair parts, etc., from stores. A form suitable for this is as shown in Fig. 6, its workings are self-explanatory.

Again it is evident how by strict adherence to the proper employment of job tickets and material requisition it becomes possible to allocate all expense and thereby have available actual costs covering not only the whole but also each unit thereof.

No attempt should be made to shoulder all of this work upon the chief engineer. Job tickets and material requisition should ultimately find their way to the

[redacted] REQ. No. — 40501

REQUISITION ON MAINTENANCE DEPARTMENT OR TOOL ROOM

From Power Dept. Date 7-2-31

FURNISH OR REPAIR THE FOLLOWING

Relieve steam and cylinder Boiler feed pump No. P-2

Workmans Report

Tool No. Tool Drwg. No. Equipment Drwg. No. Jig No.

Bldg. No. Machine No. P-2 Motor No.

Date Wanted 7-15-31 Date Promised Signed M. Jaminski

Date Finished CHARGE TO 1003 Signed

FIG. 7. NO REPAIRS SHOULD BE MADE UNLESS FORMALLY REQUESTED BY PROPER REQUISITION

accounting department which naturally should be charged with the duty of maintaining the inventory record first referred to.

Appropriations

As a matter of policy, it appears desirable not to allow incurrence of major expense without sanction of the management. In fact, few industrials permit department heads to spend more than some specified amount without the issuance of an appropriation form. Some limit unauthorized expenditures to $25.00, some to $50.00, and some to $100.00. The amount is arbitrary but should be fixed and deviation from the established ruling not allowed.

Referring to the job ticket illustrated in Fig. 5, space should be provided for an appropriation number. No charge account number need be inserted, this for the reason that the appropriation number should cover all charge numbers involved.

Appropriation forms should preferably be made in triplicate so that upon final authorization one copy can be retained in the book, the original forwarded to the accounting department, and the duplicate turned over to the management.

Appropriation expenditures are then entered daily upon a form provided for that purpose.

POWER PLANT ENGINEERING November 1933

Economical Boiler Feedwater Piping Design

Use of surge suppressor may control water hammer which now limits velocity to a value considerably below that shown by economic considerations.

By GEO. F. CAMPAU*

ALTHOUGH boiler feedwater piping design is a familiar subject to the power plant designer, there has been very little printed upon the subject of determining the most economical size of pipe or velocity of flow to use for a given installation. This article is based upon a study made to determine the most economical velocity of flow in boiler feed lines.

It seems only fair to warn the reader at this point that like many similar problems there is a "catch" in the answer. From an economic viewpoint, the velocity of flow works out to be 50 per cent higher than that customarily used. From an engineering viewpoint, there is a difficulty to be overcome before such velocities can be adopted.

Economically, the steadily decreasing cost of power has made it possible to use higher velocities of flow in boiler feed lines than has been customary in the past. The higher velocities increase the friction loss requiring higher head pumps, higher power consumption, and additional power generating capacity. The saving in fixed charges made possible by using smaller sizes of pipe and fittings more than offsets the increased power cost and fixed charges on other items.

The Most Economical Velocity

The most economical velocity of flow in feedwater piping depends upon the following factors:

1. Cost of piping including valves and fittings, which varies with a. the diameter, b. the length, and c. the wall thickness.
2. Cost of power used by the boiler feed pumps.
3. Cost of the power generating capacity to serve the boiler feed pumps.
4. Cost of equipment.

In the study made to determine the most economical velocity of flow in feed lines, a 400-lb. initial pressure power plant with a 48 per cent use factor was used. Four different sizes of pipe were considered for the feedwater lines. Having determined the layout and knowing the maximum flow conditions, the required working pressure at the boiler feed pump discharge was calculated for each pipe size. The results of this analysis are given in Table I.

Power cost and fixed charges were determined for each of the piping systems chosen to establish the most economical velocity of the various sizes of pipe. The computations are omitted to avoid too much tiresome detail. The power costs for the four piping systems, based upon theoretical load duration data, were calculated at four different rates. The results are shown in Fig. 1. The fixed charges were calculated for the piping, valves and fittings, pumps, motors, and additional power generating capacity for the boiler feed pumps made necessary by the increased friction loss resulting from the reduction in pipe diameter. The results are shown in Fig. 2. The annual operating costs were determined for the various feed lines by combining the curves in Figs. 1 and 2. The results are shown in Fig. 3. The most economical velocity or pipe size was determined from Fig. 3, which, depending on the power cost, shows the best water velocity to lie between 15 and 18 ft. per second. This would require the use of a 6-in., 600-lb. standard steel pipe.

Table I. Different Feed Piping Systems

Nominal Size of Pipe—in.	A.S.A. Rating Pounds	Required Working Pressure lb. per sq. in.
8	600	580
6	600	623
5	600	703
4	900	1052

While from an economic viewpoint, the study showed that the choice of feedwater piping should be 6-in., 600-lb. pipe, from an engineering viewpoint, the allowable fiber stress in the piping during water hammer must be considered before this size of pipe can be used.

Water Hammer

Water hammer is caused by the nearly instantaneous or too rapid closing of a valve in the line or by the tripping-out of a boiler feed pump. In the case of boiler feed lines, the possible occurrence of water hammer is enhanced by the use of quick opening and closing valves such as boiler water level regulating valves. The normal operation of such valves will not produce water hammer, but the breakage of the valve operating mechanism or the tripping-out of a pump provides a possible hazard. When water hammer occurs, an excess pressure is produced which is additive to the normal working pressure.

Calculation of Allowable Velocity

Among other factors, the excess pressure due to water hammer is directly proportional to the initial velocity. This suggests a method for calculating the allowable

*Technical Engineer, Marysville Power House, The Detroit Edison Co.

velocity of flow in feed lines when considering the working pressure plus the excess pressure. From Barlow's formula for internal fluid pressure:

$$p = 2\,St \div D$$

where

p = total allowable internal pressure, lb. per sq. in.
S = fiber stress (12,000 for medium carbon seamless steel pipe), lb. per sq. in.
t = thickness of wall of pipe, inches (deduct 12.5 per cent for under thickness).
D = actual outside diameter of pipe, inches.

Then for the 6-in., 600-lb. pipe considered in the economic velocity example

t = 0.3850 — (0.3850 × 0.125) = 0.3369 in.
S = 12,000 lb. per sq. in.
D = 6.625 in.
p = 12,000 × 2 × 0.3369 ÷ 6.625 = 1220 lb. per sq. in.

In the case of the 6-in. pipe, the required working pressure at the boiler feed pump discharge is 623 lb. per sq. in. The total allowable excess pressure for water hammer is 1220 — 623 = 597 lb. per sq. in. The allowable initial velocity, when considering the possibility of water hammer, will be the allowable excess pressure due to an initial velocity of one foot per second, which is (from the Piping Handbook by Walker and Crocker)

$$p_o = \frac{v_o}{12}\sqrt{\frac{yK'}{g}}$$

in which

p_o = excess pressure due to water hammer, lb. per sq. in.
v_o = reduction in velocity causing water hammer, ft. per sec. = 1 in this case.
y = density of liquid, lb. per cu. ft.
g = acceleration due to gravity, 32.2.

$$K^1 = 1 \div \left[\frac{1}{K} + \frac{r}{2tE}(5 - 4L)\right]$$

K = bulk modulus of elasticity of liquid, lb. per sq. in. (approximately 300,000).
r = inside radius of pipe, in.
t = thickness of pipe wall, in.
E = modulus of elasticity in tension for pipe materials, lb. per sq. in.
L = Poisson's ratio for pipe material.

The excess pressure due to an initial velocity of 1 ft. per sec. works out to be 58.5 lb. per sq. in. for a 6-in., 600-lb. medium carbon seamless steel pipe. The allowable velocity is 597 ÷ 58.5 = 10.2 ft. per sec. as compared to the most economical velocity of 15 to 18 ft. per sec. A velocity of 10.2 ft. per second would require the use of an 8-in., 600-lb. pipe for the plant used in the economic velocity example.

A test was made by the author on a feedwater line to check the calculated value of excess pressure due to water hammer. The line under test consisted of 103 ft. of 6-in. lap welded pipe in series with 250 ft. of 8-in. lap welded pipe. A quick closing, lever operated, balanced type valve was installed at the discharge end of the 6-in. pipe. An engine indicator, connected to the line about 2 ft. from the valve, was used to obtain the pressure. The velocity of flow was determined by weighed water. The desired velocity of flow was established and then the quick closing valve was suddenly closed. The resulting excess pressure due to water hammer as observed during the test was 87 per cent of the calculated value.

Pressure readings were also taken at the pump end of the 8-in. line and showed the excess pressure to be considerably less than at the end of the 6-in. line. This was due to the change in size of the pipe with a corresponding reduction in the velocity. This indicates that main headers which are free from quick acting valves are not subjected to the same hazard as the smaller branch lines containing the water level regulating valves.

It appears, then, that to attain the most economical size of pipe for feed lines, the hazard of excess pressure due to water hammer must be overcome. It is quite possible that this can be done by installing surge suppressors such as described in the A.S.M.E. Symposium on Water Hammer. The surge suppressor is a special relief valve designed to open when a surge occurs in the line and then slowly reclose. The use of such a relief valve is described in one of the papers in this same Symposium, Surge Control in Centrifugal Pump Discharge Lines, by Ray S. Quick. He gives results of a test in which the excess pressure without a "surge suppressor" was approximately 35 per cent of the normal pressure and by using a surge suppressor the excess pressure was limited to approximately 9 per cent of the normal pressure.

In the example used in the economic study, the 6-in., 600-lb. line shows a saving of 19 to 25 per cent, depending upon the cost of power, over the 8-in., 600-lb. line. In the engineering study, however, the allowable fiber stress during water hammer would limit the velocity of flow to 10.2 ft. per sec. and would require the use of the 8-in., 600-lb. line. Considering the saving that can be made in the annual cost of boiler feedwater piping by increasing the water velocity over what has been customary, a serious attempt should be made to overcome the hazard of water hammer.

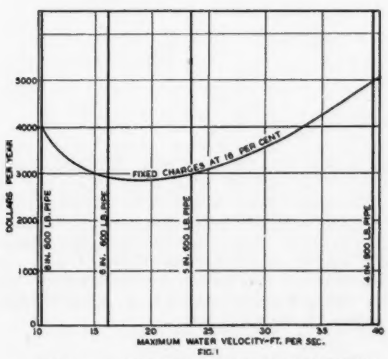

DOLLARS PER YEAR
FIXED CHARGES AT 15 PER CENT
8 IN. 600 LB. PIPE
6 IN. 600 LB. PIPE
5 IN. 600 LB. PIPE
4 IN. 600 LB. PIPE
MAXIMUM WATER VELOCITY—FT. PER SEC.

FIG. 1. ANNUAL FIXED CHARGES

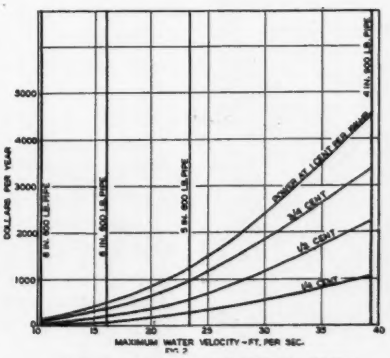

DOLLARS PER YEAR
8 IN. 600 LB. PIPE
6 IN. 600 LB. PIPE
5 IN. 600 LB. PIPE
4 IN. 600 LB. PIPE
POWER AT 1 CENT PER KWH
¾ CENT
½ CENT
¼ CENT
MAXIMUM WATER VELOCITY—FT. PER SEC.

FIG. 2. ANNUAL POWER COST

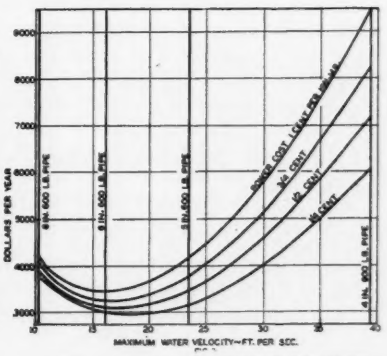

DOLLARS PER YEAR
6 IN. 600 LB. PIPE
8 IN. 600 LB. PIPE
5 IN. 600 LB. PIPE
4 IN. 600 LB. PIPE
POWER COST 1 CENT PER KWH
¾ CENT
½ CENT
¼ CENT
MAXIMUM WATER VELOCITY—FT. PER SEC.

FIG. 3. TOTAL OPERATING COST

POWER PLANT ENGINEERING November 1933

Parallel Operation of Single Phase Transformers

Proper parallel operation demands that certain conditions be fulfilled dependent upon the constants of the transformers.

By
EDWARD W. JOHNSTON

WHEN TRANSFORMERS are operated in parallel three conditions must be fulfilled.

1. The secondary currents should all be zero when the load on the system is zero.

2. The secondary current carried by each transformer should be proportional to its rating.

3. The secondary currents carried by each transformer should be in phase with each other and in phase with the currents taken by the load on the system.

Upon the ratios of transformation and the constants of the transformers will depend whether these conditions are fulfilled. Even though the ratios of transformation are the same, the transformers cannot be paralleled indiscriminately.

Since the same voltage is impressed on the primaries of all transformers operating in parallel, the primary terminal voltages must be exactly equal and exactly in phase. Also since all the secondaries are connected together, all of the secondary terminal voltages must be equal and in phase. If the ratios of transformation are equal, the primary voltages referred to the secondary side will be equal and in phase, and if the exciting currents are neglected, the equivalent impedance drops of all the transformers will be equal and in phase since they must form the closing side of a voltage triangle which has for its other two sides the common impressed primary voltage referred to the secondary windings and the common secondary voltage.

When a transformer is paralleled with others, the current it will deliver depends merely upon its equivalent impedance and not upon the manner in which the resistance and reactance are distributed between its primary and secondary windings.

Fig. 1, represents the conditions for two transformers when their ratios of transformation are not equal. The drops are exaggerated to make the diagram clear. This shows that unless the ratios of the primary to the secondary resistances of all the transformers are equal and the ratios of the primary to the secondary reactances are also equal, the induced voltages will neither be equal nor in phase.

abc and abd represent two equivalent impedance triangles. Each of these triangles is made up of two parts, the drop in the secondary winding and the drop in the primary winding referred to the secondary aie and ajf are the two impedance triangles for the secondaries and ibh and jbg are similar triangles for the primaries referred to the secondaries. Unless

$$\frac{r_1'}{r_2'} = \frac{r_1''}{r_2''} \text{ and } \frac{x_1'}{x_2'} = \frac{x_1''}{x_2''}$$

i and j, that is E_2' and E_2'' cannot coincide. r_1' and r_2' are respectively, the primary and secondary resistances of one transformer and r_1'' and r_2'' are the corresponding resistances of the other. Unless E_2' and E_2'' are equal and in phase, there will be a resultant voltage acting in the series circuit consisting of the two secondary windings.

This resultant voltage will not cause any additional current since it is balanced by the impedance drops already existing in the two secondary windings. For a similar reason, the resultant voltage due to the difference between the two primary induced voltages will be balanced by the impedance drops in the two primary windings. If the secondaries are taken for an example, the secondary voltages will be V_2' and V_2''. These must be equal and in terms are each respectively equal to

$$E_2' - I_2'z_2' \text{ and } E_2'' - I_2''z_2''$$
$$E_2' - I_2'z_2' = E_2'' - I_2''z_2''$$
$$\text{and } E_2' - E_2'' = I_2'z_2' - I_2''z''$$

From this equation it will be seen that the difference between the two secondary induced voltages which act in the circuit consisting of the two secondary windings in series is balanced by the impedance drops due to the exciting secondary currents I_2' and I_2''. If the load is zero, I_2' and I_2'' will be equal. The difference between the two primary induced voltages is similarly balanced. Thus, it follows that the current output of any trans-

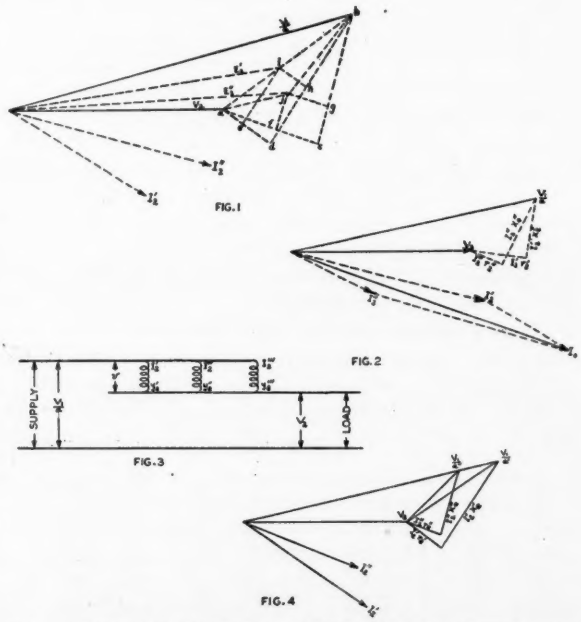


FIG. 1. VECTORS OF TWO TRANSFORMERS WHERE THE RATIOS OF TRANSFORMATION ARE NOT EQUAL
FIG. 2. VECTOR DIAGRAM FOR TWO TRANSFORMERS HAVING EQUAL RATIOS OF TRANSFORMATION
FIG. 3. EQUIVALENT CIRCUIT FOR TRANSFORMERS HAVING THE SAME RATIO OF TRANSFORMATION
FIG. 4. VECTOR RELATIONS WHEN TRANSFORMERS OF DIFFERENT RATIOS OF TRANSFORMATION ARE OPERATED IN PARALLEL

former which is in parallel with others having the same ratio of transformation is not affected by the distribution of the resistances and reactances between the primary windings but depends merely upon the equivalent impedance.

If the secondary currents delivered by any number of transformers which are connected in parallel be I_2' I_2'' I_2''' etc. and the equivalent impedances and equivalent admittances all referred to the secondary windings be respectively z_e', z_e'' z_e''' etc. and y_e' y_e'' y_e''' etc. then since the impedance drops must all be equal.

$$I_2'z_e' = I_2''z_e'' = I_2'''z_e''' \text{ etc.}$$

and

$$I_2' : I_2'' : I_2''' \text{ etc.} = \frac{1}{z_e'} : \frac{1}{z_e''} : \frac{1}{z_e'''} \text{ etc.} = y_e' : y_e'' : y_e''' \text{ etc.}$$

The currents delivered by the transformers to the load are therefore inversely proportional to their equivalent impedances. The total current I_o, delivered by the system will be the vector sum of the component currents delivered by the separate transformers,

$$I_o = I_2' + I_2'' + I_2''' \text{ etc.}$$

Fig. 2, is a vector diagram for two transformers having equal ratios of transformation. The no load current is neglected. In the diagram, the impedances are in the ratio of 2 to 1, hence,

$$\frac{I_2'}{I_2''} = \frac{z_e''}{z_e'} = \frac{y_e'}{y_e''} = 2$$

If the two impedances were equal, the currents would also be equal. The currents can be in phase only when the ratio of the equivalent resistance of each transformer to its equivalent reactance is the same for both transformers.

The proper division of load between any number of transformers which operate in parallel is that which causes all the transformers to reach their maximum safe temperature at the same time. From this it must not be implied that the current supplied by each transformer will be in proportion to the manufacturer's rating because this rating may be more conservative for some than others. The maximum safe temperature of different types may not be the same.

Fig. 3, represents the equivalent circuit for transformers having the same ratio of transformation. The division of load between any number of transformers may be found from equations and will not be discussed here. The distribution of the load between transformers with equal ratios of transformation is independent of the load on the system or its power factor.

In cases of transformers of different design but having the same nominal ratios of transformation, the actual ratios of transformation may differ slightly from each other. Differences of this kind are most likely to occur in transformers having ratios of transformations which are not whole numbers, since in such cases it may be impossible to make the ratios of the primary to the secondary turns exactly the same as the desired ratios of transformation. Vector relations which exist when two transformers have different ratios of transformation are operated in parallel are shown in Fig. 4. It can be shown mathematically that the total current I_o delivered by the system is equal to the component currents delivered by the separate transformers and that if the ratios of transformation of the transformers are not the same the current output of any transformer will consist of two components, one component depending upon the load and the other nearly independent of the load.

The four conditions which must be observed in the parallel operation of transformers, stated in the order of their relative importance are:

1. Equal voltage ratings.
2. Equal ratios of transformation.
3. Equivalent impedances which are inversely proportional to their current ratings.
4. Ratios of equivalent resistances to equivalent reactances which are equal.

If the voltage ratings are not the same, some will be operating on a higher voltage than that for which they are designed and some on a lower.

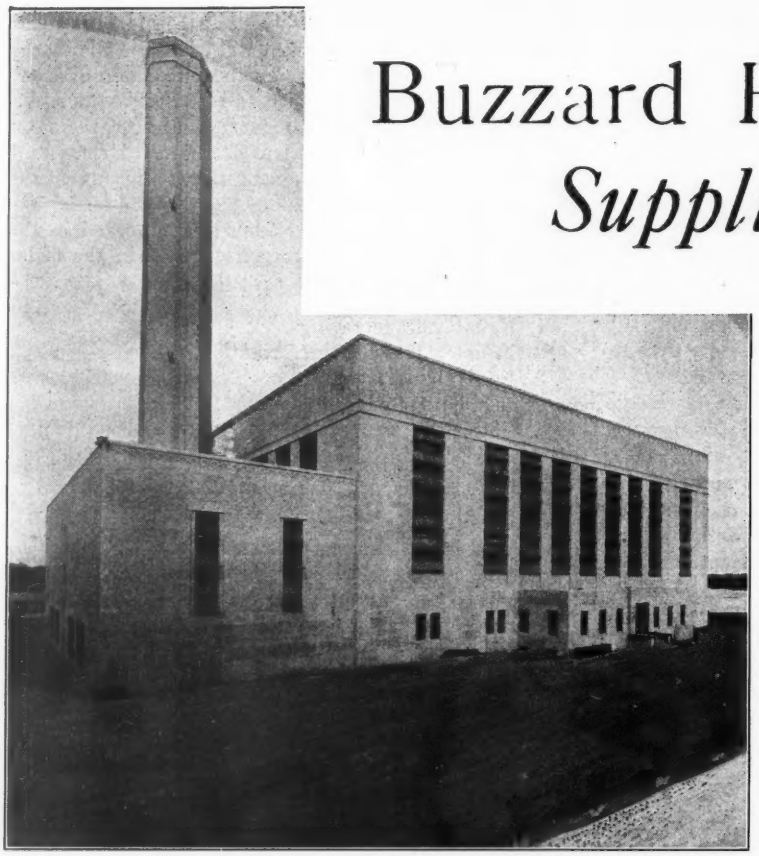
If the ratios of transformation are not the same, there will be currents in the transformers in addition to the exciting currents when the load on the system is zero. The magnitude of these currents will depend upon the differences between the ratios of transformation and they cannot be eliminated without redesigning the transformers.

If the impedances are not inversely proportional to the current outputs which produce the maximum safe temperature rise in the transformers, the transformers will not divide the load properly and some will become overheated while others are below their safe temperatures, unless the system is operated at less than the total rated capacity.

If the ratios of equivalent resistance to equivalent reactance are not the same for all of the transformers, the currents delivered by them will not be in phase with each other or with the load currents and the transformers will be carrying kilowatt loads which are not proportional to their current loads. As a result, the copper loss for given load on the system in all of the transformers and in the system as a whole will be greater than it would be if all of the currents were in phase. In other words, the maximum safe kilowatt output of the system will be diminished.

Where the impedances are not in the proper ratio and there are unequal ratios of resistance to reactance, these faults may be corrected by inserting the proper amount of resistance or reactance or both on either the primary or the secondary sides of the transformers.

UNTIL RECENTLY, Mazda lamps for 115 v. could not be made in sizes smaller than 10 watts, because of the incredibly small filament required and even the 10-watt size was none too strong. But 5-watt lamps are now being made and are quite rugged. The filament is coiled in a close helix which itself looks no larger than an ordinary filament. When the helix is pulled out, the straight wire disappears to any but good eyes in a good light! It is four ten-thousandths of an inch in diameter, a fifth the thickness of a hair, and is produced by pulling it through a hole in a diamond.



Buzzard Point Plant *Supplies Power to* Capitol

First 35,000-kw. Section Plant Just Going into Service Has Many Innovations in Boiler and Turbine Arrangement.

By H. G. THIELSCHER,

Mechanical Engineer, Potomac Electric Power Co.

INCORPORATING many novel features, the new Buzzard Point Station of the Potomac Electric Power Co., Washington, D. C., will augment the output of Benning Station and the recently completed 230,000-v. transmission line from Safe Harbor. This, the first section of a six unit station is expected to be in preliminary operation this month (November) and consists of a 35,000-kw., 1,800-r.p.m., 650-lb., 850-deg., 13,800-v., 60-cycle, single cylinder, General Electric turbo generator and two 375,000-lb. per hr., 750-lb., 850-deg. F. single pass, cross drum, Babcock & Wilcox boilers with economizers, air heaters and electrostatic precipitators. The design contemplates an ultimate installation of six turbo generators and six boilers to be operated on the basis of one boiler per turbine.

Architecture Conforms to General Style

Located near the junction of the Potomac and Anacostia Rivers the plant has adequate railroad facilities, is near the port development and deep water and located so that a tie in with the distribution system can be made at generator voltage without the need for step up and step down transformers and sub-stations. The building exterior was designed to conform with the architecture of the major structures in the Capitol City.

Boilers are designed to burn a variety of coal, fuel oil or gas. West Virginia coal will be burned initially and particular attention was given to the matter of smoke and dust emission, not only from the stack but from the coal storage and handling facilities. The boilers are of the single pass cross drum type with vertical pulverized coal firing and slag tap bottoms. A cross section is shown by Fig. 1. Both superheater and economizer are located directly above the boiler bank, separated from each other by a water cooled baffle. After leaving the economizer the gases are directed by a sloping baffle so as to have even distribution into and through the air heater to the electrostatic precipitator arranged three sections deep to insure thorough cleaning of the gases. Throughout, the design has been made with particular reference to providing a smooth flow of gas with elimination of cinder and soot pockets.

Capacity Can Be Increased

Each boiler has two Riley pulverizers for an initial capacity of 375,000 lb. per hr. of steam although provision has been made to increase this in the future by the addition of another pulverizer and more burners. As no curtain wall is provided between the turbine and boiler room the coal bunker is totally enclosed with a direct flow of coal from the bunkers to the pulverizers.

Furnaces are completely water cooled with a staggered refractory covered tube slag screen across the throat of the furnace just above the level of the burners. These are fired downward so that the flame impinges on the slag at the bottom causing the larger slag particles to be thrown off at this point. The slag screen tubes are spanned sufficiently far apart to prevent bridging and the refractory covering is designed to keep the slag fluid enough to run down and drip off.

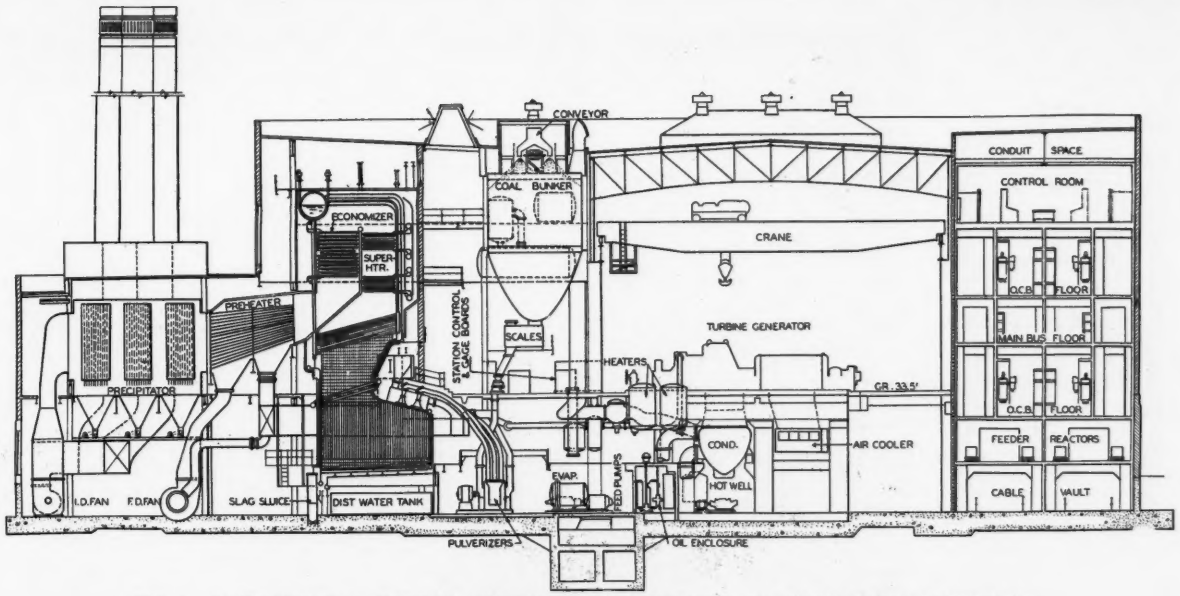


FIG. 1. LONGITUDINAL SECTION SHOWING ARRANGEMENT OF MECHANICAL EQUIPMENT

The superheater is of the parallel flow type built in two sections with a deheater between to control the final steam temperature. This arrangement prevents excessive temperatures in the superheater coils themselves allowing low carbon steel tubes to be used and of course gives the same protection to the turbine as a deheater at the exit of the superheater when it is more commonly used with lower temperatures.

The turbine is an 18 stage, 35,000-kw. 1,800-r.p.m. General Electric unit set crosswise of the turbine room over a 30,000-sq. ft. single pass Ingersoll Rand condenser. Three stages of extraction heating, using Foster Wheeler open heaters are employed in the cycle, although a fourth closed desuperheater heater in the high pressure extraction line raises the final feedwater temperature several degrees over saturation temperature from the high stage heater.

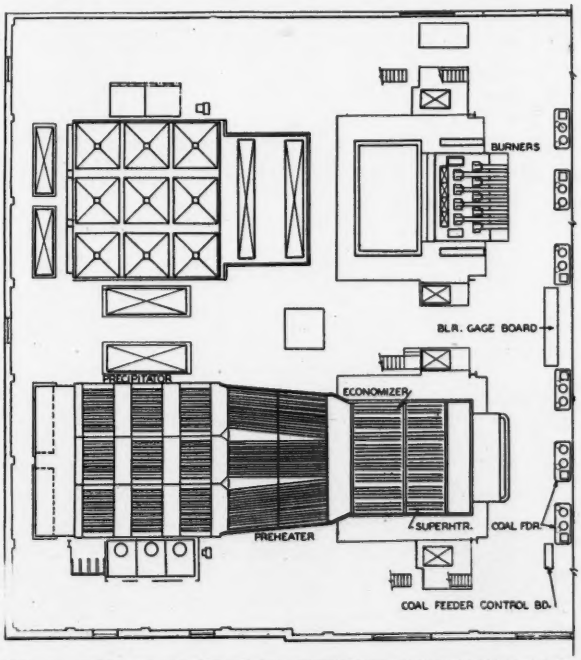


FIG. 2. BOILER ROOM PLAN SHOWING LOCATION OF AIR HEATER AND DUST COLLECTOR

Oil System Safety

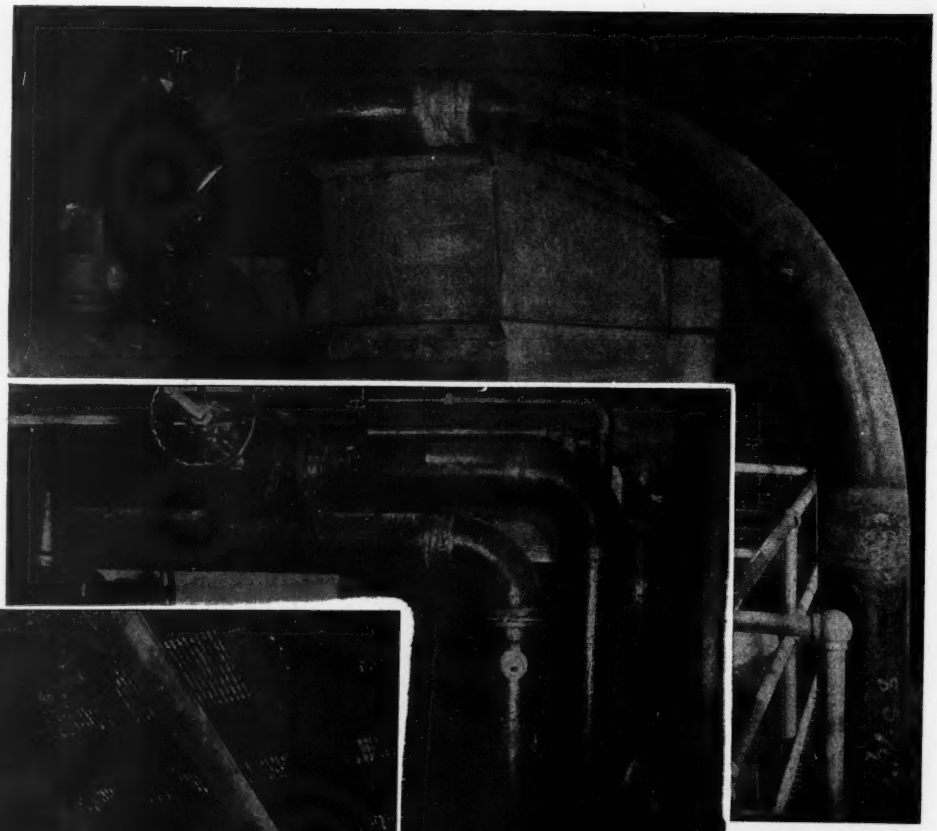
Other interesting features of the turbine room are the provisions against oil fires. All turbine oil equipment such as main and auxiliary pumps, oil purifiers, strainers, coolers and reservoirs are located in a fireproof room immediately under the turbine and all high pressure oil piping to the governor, bearings and extraction line valves are run inside of and are spot welded to the top of the welded low pressure return lines. A separate CO_2 system has been provided for the oil room. steam line flanges are also protected by a special covering of high temperature insulation, asbestos and aluminum foil designed for ready removal.

Natural gas is largely: Methane with heat value 970 B.t.u. per cu. ft. at 60 deg. and atmospheric pressure; ethane, 1719 B.t.u. per cu. ft.; propane, 2464 B.t.u. per cu. ft.; a small percentage of carbon dioxide and nitrogen and varying amounts of vapor which can be removed by absorption or by condensation under pressure. The former is the usual method. The lower the pressure, whether casing-head or dry gas, the greater will be the gasoline content, as more of the lighter gasoline will be taken up from the oil or oil-bearing sand with which the gas is in contact. Dry gas is usually considered to have less than 1 gal. of gasoline per 1000 cu. ft. and will always come from wells of large yield.

Gasoline removed by absorption is about 80 deg. Baumé, with heat value 21,500 B.t.u. per lb. or 119,400 B.t.u. per gal., vapor from a gallon. For dry gas, yielding only 0.1 gal. gasoline per 1000 cu. ft. of original gas. heat value loss is under one per cent. For rich gas yielding 4 gal. per 1000 cu. ft., the loss is 11.8 per cent but, after removal of the gasoline, that gas has a heat value over twice that of the dry gas before gasoline removal. hence heating value of the remaining gas is still good. Where gasoline yield is large, the consumer after its removal will have a gas supply of higher heat value than that for untreated dry gas.

Welded Boiler Plant Piping

Typical Examples of Oxy-Acetylene Pipe Welding in a Small 135-lb. Boiler Plant



8-in. lead from 400 hp. boiler, 135 lb. pressure

Tunnel entrance, pipes to be insulated

Condensate vacuum pump discharge

Above—12-in. exhaust line, 12 to 8-in. reducer, 8-in. line and 4-in. line connected by a single fitting

Low upkeep on these connections

Oil Engine Power Costs

PRODUCTION COSTS of oil engine power plants, consisting of fuel, lubrication, attendance and superintendence, engine and plant repairs, supplies and miscellaneous costs, are given in the preliminary report on oil engine power costs for 1932 as collected by the A.S.M.E. Unit costs referred to are calculated on the basis of net kilowatt-hours found by subtracting power used for plant auxiliaries and station lights from the total gross output of the plant.

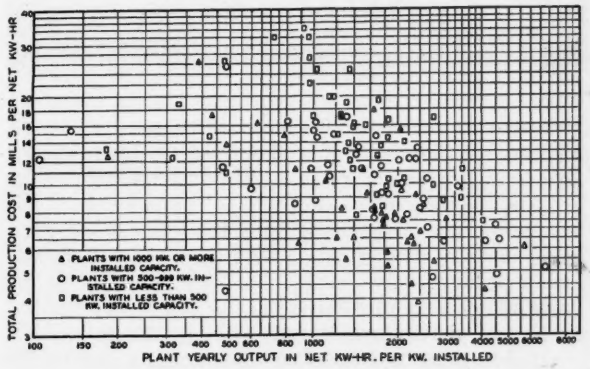


CHART SHOWING COST OF DIESEL POWER

The report includes information from 140 oil engine generating plants, containing 377 engines totaling 213,910.5 rated brake horsepower and the total net output of 282,446,690 kw-hr. Total production costs for 135 of the plants reporting for one year each are shown graphically on logarithmic coördinates in the accompanying chart. In this chart the total production cost in mills per net kilowatt-hour is plotted against specific output or the output in net kilowatt-hours per year per kilowatt of installed capacity.

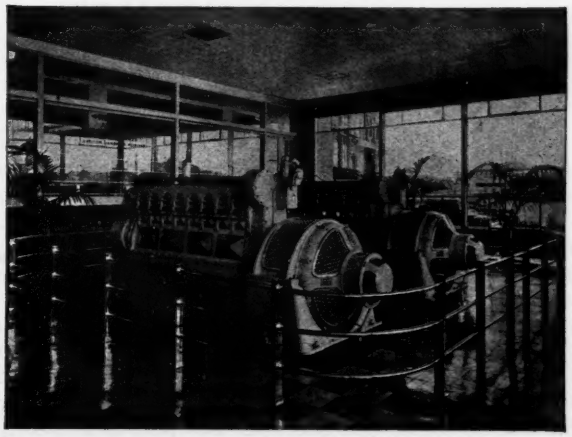
In the original report complete tabulated data are given with five additional charts showing the lubricating oil economy, fuel oil economy and attendance costs.

Oil Electric Sets at World's Fair

AT THE WORLD'S FAIR, two Winton engines driving Westinghouse generators supply power for the General Motors Building, the installation embodying the latest developments in engineering practices. Figure 1 shows a general view of the sets. Each generator is rated at 500 kv-a., 4000 v., 3 ph., 60 cycle, 720 r.p.m., with 120-v. direct connected exciters. The two generators operate in parallel supplying energy to the transformer bank for supplying power to the building.

Each generator is connected, through a set of disconnecting switches and an oil circuit breaker to a main bus, to which is connected, also through an oil circuit breaker and set of disconnecting switches, the 4000-v. transformer circuit. The control and switching equipment are mounted on and within metal enclosed cubicles, one for each generator and one for the transformer circuit.

Each generator circuit, also the transformer circuit are equipped with inverse time limit overload relays which will operate to trip the respective breakers on overload or short circuit. The indicating instruments



OIL ELECTRIC SETS FOR SUPPLYING POWER TO GENERAL MOTORS BUILDING AT A CENTURY OF PROGRESS

are Westinghouse standard Type H, rectangular, projection mounting with dull black finished metal cases. The watthour meters and graphic meters are standard switchboard types, with glass cases. All alternating-current meters and instruments have coils suitable for use with 5-amp. current and 110-v. potential transformer secondaries. The protective relays, with the exception of instantaneous and auxiliary relays, are induction disc types. The control and instrument switches are of drum construction.

Use Welding Torch to Remove Broken Stud

By W. E. WARNER

STUDS that are broken off flush with the surface or below it can be removed as follows: Procure an ordinary plate washer the central hole of which is slightly smaller than the stud to be removed. Place this centrally over the stud, then get an oxyacetylene torch. play a flame through the hole in the washer and feed in weld metal so that the stud is welded to the washer through the central hole.

Any possibility of welding the washer to the casting can be prevented by placing a little powdered graphite between the washer and the casting. There should, however, be no risk of this, provided a small flame is used. A bronze rod can be used for filling. When welding is complete the washer can easily be turned around by pipe wrench or driven around with a hammer and center punch. Broken taps can also be removed in this way.

POWER PLANT ENGINEERING November 1933

Glory Hole Spillway

Control at Owyhee River Dam, Oregon, by Ring Gate, Vertical Intake and Horizontal Tunnel.

By A. P. CONNOR*

INFREQUENTLY used for dams, the Glory Hole spillway is of special interest in this case because it is with the, at present, highest dam in the world. As shown in Fig. 1, the spillway is placed 350 ft. upstream from the dam, a shaft 308 ft. deep with a 12-ft. ring gate at the top so that water level above the dam can be controlled. At the top of the funnel, diameter is 54 ft., tapering rapidly to 32 ft., then more gradually to 23 ft. At the bottom the shaft joins a horseshoe tunnel by a long sweep elbow, this tunnel being part of a diversion tunnel used during construction of the dam, which now has the up-stream end plugged. The part now used is 750 ft. long and has a capacity of 40,000 sec. ft. when water level is at elevation 2672 ft., the same as the capacity of the ring gate crest at that water level.

Installed in Oregon, near the Idaho border, the dam is for irrigation purposes but arrangements are provided to develop hydroelectric power from it, at a future date.

Ring Gate Control

Mounted at the crest portion of the glory hole is an open valve or ring gate, the first of its kind, operable in an annular concrete chamber. The general construction is shown in the sectional views herewith. The ring gate is a substantial metal structure, built in a series of segmental tanks, 15 ft. high, by 4 ft. in horizontal thickness. These tank segments were joined together in the field after being placed and arranged in the annular chamber. The gate is made water-tight, manholes being provided at suitable points to permit the interior to be inspected or repaired. The crest is rounded as shown and projects inwardly to rest on the spillway, rubber ring seals preventing water leaking into the gate chamber past the sides of the ring gate. Counterweights operate the control valves that supply the water to the ring-gate chamber, in conjunction with a float in a float well and a pedestal valve connection. An indicator in the valve house shows the position of the gate with regard to the top of the spillway crest.

Pinion gears and racks on the ring gate and on the wall of the ring-gate chamber, with guide rollers at the crest on the outside serve to guide the gate accurately and preventing binding.

To raise the gate, inlet control valves allow water from the lake to enter the ring-gate chamber, to float the ring gate and raise it. As the lake rises, it permits the ring gate to be raised higher, until the limit of 12 ft. is reached. Stops limit the movement at upper and lowest points of travel. When it is desired to lower the ring gate this inlet valve is closed or partly shut-off and the outlet control valves are opened to drain water from the gate chamber into the spillway shaft. By manipulation of inlet and outlet valves, position of the gate may be controlled as desired. Use of the float in its well permits automatic lowering of the ring gate whenever it exceeds any predetermined limits, especially if the inlet valve is closed. If the water in the lake should rise above normal high water, the float will operate the valves

* Washington, D. C., Correspondent.

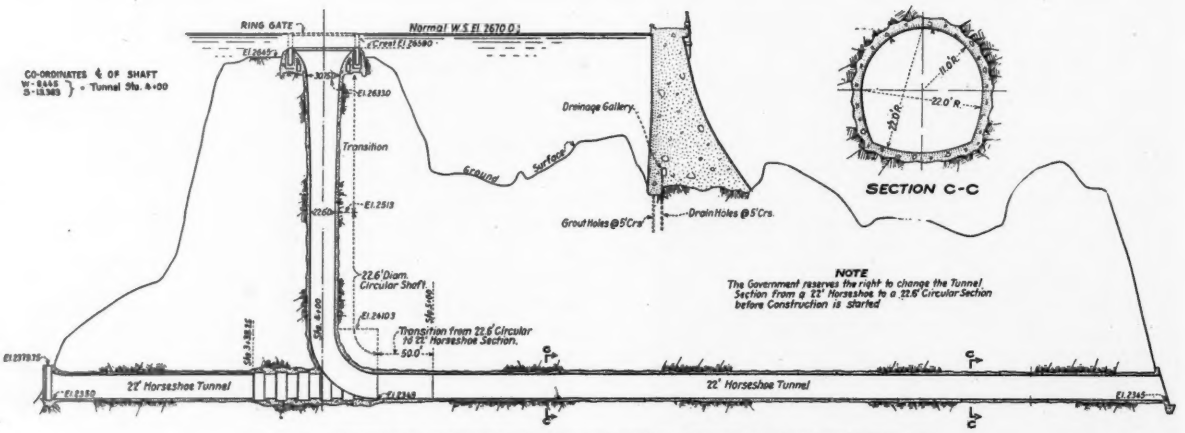


FIG. 1. SECTION THROUGH GLORY-HOLE TUNNEL AND SPILLWAY

to permit the ring gate to drop to permit more water to flow into the glory hole spillway. This permits the flood to pass into the glory hole up to the amount of 30,000 sec. ft. Should the lake rise higher and reach 5 ft. above, which is level of the highway, the spillway will handle 40,000 sec. ft. With the passing of the flood and decrease of the flow, the ring gate will automatically rise to its upper position and continue to conserve the water storage, a valuable feature, since it makes the maximum use of the water available and requires but little attention. The whole arrangement avoids the use of motors and power mechanism.

Handling ice in winter at the ring gate is not a serious problem, as the level of the lake can be left at the "crest" height of the spillway, with the ring gate down in the spillway chamber and drains open to prevent the accumulation of water in the spillway chamber.

Besides the spillway, a system of valves of special construction in the dam may be used for flowing off water at any time.

Engineering work and supervision of the dam was done by the United States Reclamation Bureau, under the direct charge of George O. Sanford, Chief of the Engineering Department at Washington, D. C., and B. F. Walter, Chief Engineer at Denver, Colo.

While the dam is practically completed and storage of water is in process, it will not reach the crest for some time to come.

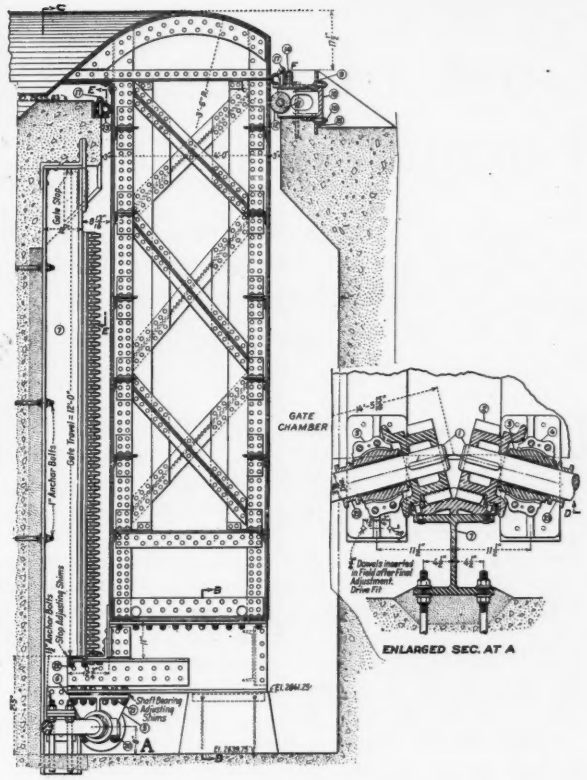


FIG. 2. SECTION THROUGH RING GATE AND DETAIL OF GUIDE GEARS AND RACK

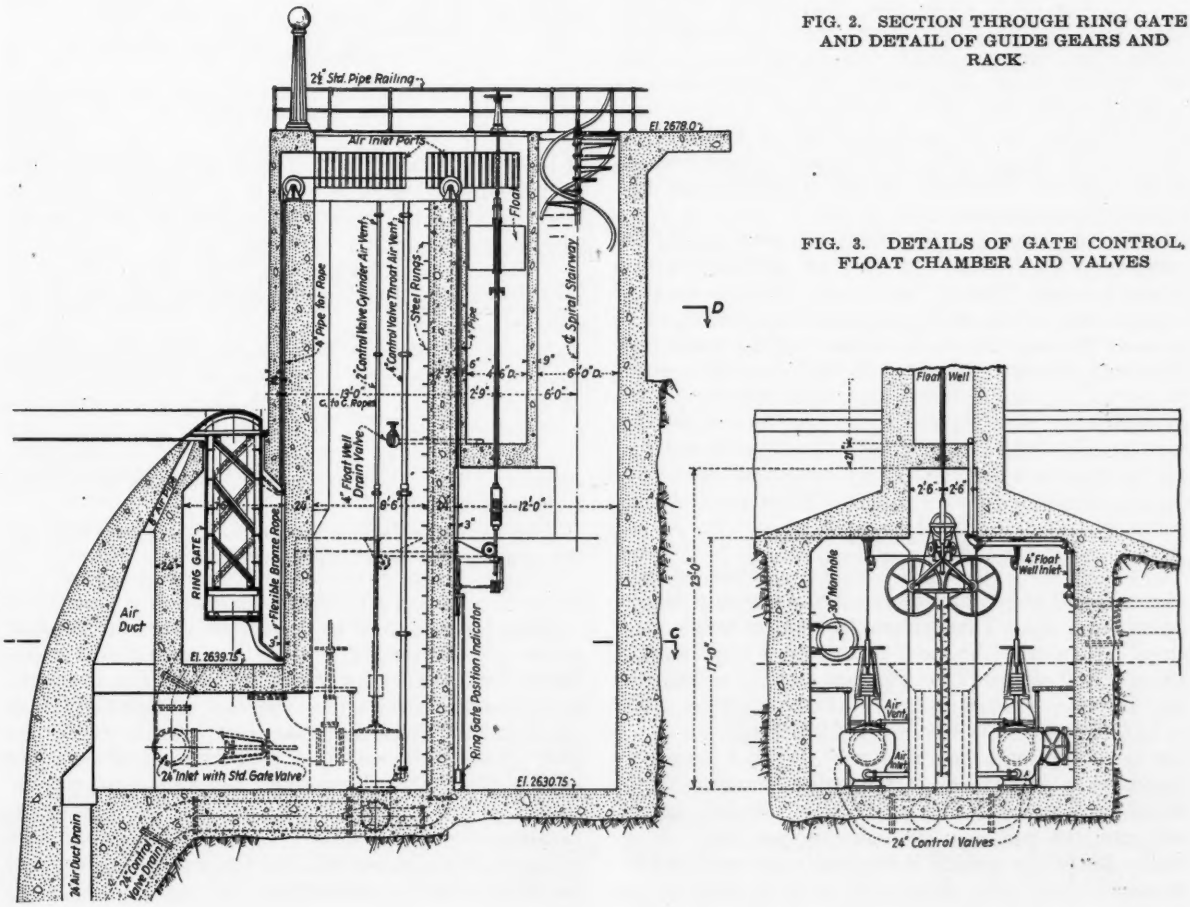


FIG. 3. DETAILS OF GATE CONTROL, FLOAT CHAMBER AND VALVES

Cost of Open Furnace Doors

A lesson illustrating the old proverb: It is wise to look before leaping—at conclusions.

By GEO. P. PEARCE

I NOTICE the gang on the large forging machine has propped the furnace door open," casually remarked the plant engineer to the forge shop superintendent.

"Why yes, Jack, I gave them permission. In fact, Jerry, the heater, suggested it and it's a good idea. It saves two steps and the motion of opening the door. As the heat doesn't shine on anyone it causes no trouble. Of course a little extra oil is used but that is considerably more than balanced by the 10 per cent increase in output," carefully explained the superintendent, for he had expected the plant engineer to raise some objection and was all prepared for him.

"Say, Henry, have you metered the oil per pound of stock heated to know exactly how much extra you are taking?" asked the engineer.

"No, I haven't, Jack. Our oil to stock ratio was established last fall and those production tests cost money. You know we don't want to spend a cent now that we can avoid. But surely the increase can't be much. Suppose the loss is as much as 35,000 B.t.u.'s per hour; what of it? An extra quart of fuel oil. We lose a penny to gain fifty. That's good sound business sense, isn't it?" answered Henry, feeling he had now clinched the argument.

"Well, it sounds all right the way you put it, but you admit it's a guess. Suppose we just cheek up on things a little. First of all that's a high production furnace and that means, in our case, a high temperature furnace. During tests we have measured the combustion zone temperature at 2950 to 3020 deg. F. with an accurate optical pyrometer. Let's take it at 3000 deg. to use round figures. Now we'll start by figuring the radiated heat loss per square foot of opening per hour and I've got the standard formula in my note book," said the engineer reaching into his pocket. "Here it is:

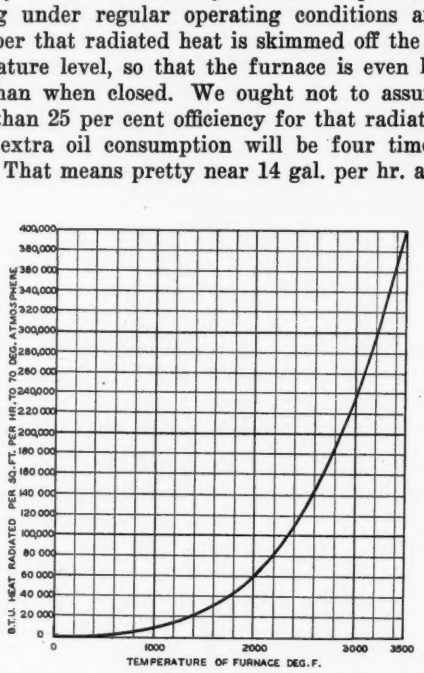
B.t.u. radiated per sq. ft. per hr. =

$$0.1618\ [(T_1 \div 100)^4 - (T_2 \div 100)^4]$$

where T_1 = Temperature in furnace in absolute degrees Fahrenheit; T_2 = Temperature in room in absolute degrees. If we take the room temperature at 70 deg. F. and add 460 we get T_2 as 530 deg. and T_1 is 3460 deg. The formula becomes B.t.u. = $0.1618\ [34.60^4 - 5.30^4]$ = $0.1618\ [1{,}433{,}000 - 790]$ = 232,000 B.t.u. per sq. ft. per hr., according to my slide rule. When I passed the furnace I measured the door opening, and it is 22 by 14 in., which makes 2.14 sq. ft. area. So you see the heat radiated per hour through the open door will be $2.14 \times 232{,}000$ = 496,500 B.t.u.s every hour you run the furnace."

"Gosh, that's a lot more than I estimated," admitted the superintendent. "Why, dividing that by 140,000 gives over 3½ gal. of oil extra per hour that we must burn to balance the loss. That reduces our gain to about—"

"Hold on there, Henry," cut in the engineer. "You're guessing too low again. Remember the overall efficiency of that furnace is just under 30 per cent when running under regular operating conditions and also remember that radiated heat is skimmed off the highest temperature level, so that the furnace is even less efficient than when closed. We ought not to assume any better than 25 per cent officiency for that radiated heat so the extra oil consumption will be four times your figure. That means pretty near 14 gal. per hr. at a cost



HEAT RADIATED FROM FURNACE DOOR AT VARIOUS TEMPERATURES

of 56 cents besides about 400 cu. ft. of extra combustion air per minute heated to burn it. All you can figure is loss on that open door idea, no matter how much more convenient it is for the operator."

"That prop's coming out right away. I never thought we were heading into anything like that," admitted Henry.

"Never guess at things if you can use even the crudest figures. Say! I've got a heat radiation chart in my office that I made up one day and I'll send you a blueprint of it. You can show it to the fellows and give them some idea of the importance of keeping their furnace tight and the door closed," said the plant engineer as he left.

The next morning the forge shop superintendent got the print which is shown herewith.

WHAT IS STATED to be the largest steam turbine-generator set so far constructed in Czecho-Slovakia has lately been installed by the Skoda Works Co. of Prague at the central electric power station at Ervenice. It is rated at 35,000 kva. and generates power at 6300 v. at 3000 r.p.m. using steam at a pressure of 266 lb. per sq. in. The Skoda Works Co. has also recently completed for the Trebovice power station two three-stage turbines developing 32,000 hp. at 3000 r.p.m. with steam at 1736 lb. per sq. in., the highest pressure so far utilized in Czecho-Slovakia.

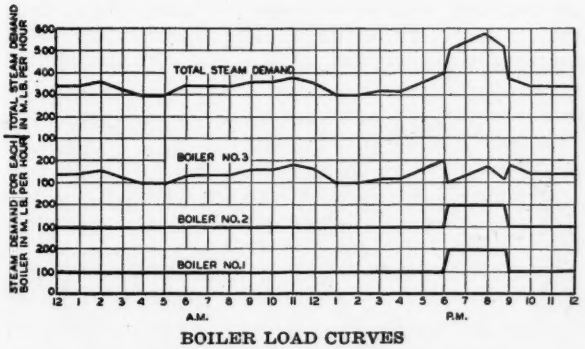
Readers' Conference

Boiler Operation for Maximum Efficiency

TWO METHODS of operating a battery of boilers are in common practice, one with the swing of the load taken on all of the units, the other, used by some of largest and most up-to-date central stations, with the swing of the load on the battery taken by only one of the units.

The writer has tried both systems and believes that the latter is superior to the former. The excess air loss is the largest boiler loss and is the most controllable. My experience has been that if the load variations are distributed on all the boilers, the operator cannot effectively steady the air-fuel ratio.

Suppose that the boiler is equipped with some sort of instruments to indicate the amount of air and also the amount of fuel. The steam flow indicates the fuel burned, while a CO_2 machine air flow meter will show the quantity of air used. These instruments are not instantaneous in their response, and whenever an adjustment is made either in the air or fuel, some time elapses before the operator knows if the adjustment is right or not. Since the load encountered in the average power plant is continuously changing, close control is impossible if all the boilers take the swing. But if only one boiler swings with the load, then the air-fuel ratio can be maintained accurately on all the others.



BOILER LOAD CURVES

This is further illustrated by the diagram. The upper curve gives the steam demand on all the boilers, which is a typical Sunday load for a central electric station. The three lower curves give the load on each boiler, the first two being operated at uniform rating and the third boiler takes the swing. It is seen that on boilers 1 and 2 the air-fuel ratio is set correctly at midnight and remains so until 6 p. m. when it is again set and remains at the new setting until 9 p. m., and is then again reset. In this particular case, the loss due to lack of synchronism between air and fuel is present only in the case of boiler No. 3, or two-thirds of this loss is saved.

I have made a large number of tests in the attempt to ascertain the magnitude of this loss. At one power plant consisting of four 1000-hp. boilers, many CO_2 observations were made of boilers operating at steady and variable loads. With a steady load, the excess air could be maintained at 40 per cent, but with the boiler that took the swing, the excess air varied from 40 to double that amount, or an average of approximately 60 per cent. This was equivalent to slightly over 1 per cent in efficiency and since this increase was realized in three out of the four boilers, the net gain in fuel was about 0.8 per cent.

Chicago, Ill. N. T. PEF.

Temperature Control Equipment

IN THE SEPTEMBER number of POWER PLANT ENGINEERING is an interesting article by Thomas Sheehan, page 399, entitled, "Temperature Control Equipment Installed Inexpensively."

I do not wish to take issue with anything written in that article, but I would like to make some comments on the drawing, Fig. 1, which shows radiators of a type that are now becoming obsolete. In the old vertical type we have parallel flow from the bottom to the top while with the modern horizontal type we have cross flow and a shelf across the top that diverts the heated air out into the room.

In addition to the money saved by means of the temperature control system, much more can be saved by installing up-to-date horizontal, built-in, fin-type radiators. Radiators of this new type have been shown by test to give better heat distribution—higher temperature on the floor and lower temperature on the ceiling.

Newark, N. J. W. F. SCHAPHORST.

Diesel Engine Lubrication

IN THE ARTICLE on Diesel engine lubrication, in the September issue, I think that Mr. Kenworthy could have gone a little farther in his comments on viscosity and its relation to lubrication. In my experience with Diesels and other machines needing lubrication at high temperatures, the viscosity of oils, as usually taken at 100 deg. F., has little to show us on the actual lubricating values at high temperatures.

To cite a concrete case of two oils from different West Virginia refineries situated within a few miles of each other and supposedly from local crudes which are inferior to none, one showed a viscosity of 1200 at 100 deg. F. and 70 at 210 deg. F. while the other had a viscosity of 500 at 100 deg. F. and 75 at 210 deg. F. Used on the same engine with continuous runs of one to three months, the former oil left the cylinders perfectly dry, while the second left a fine film of oil after constant use.

The operating engineer, an old time steam engineer, had a theory which he demonstrated by adding one gallon of vegetable castor oil to each ten gallons of lubricating oil. As it was done with both oils, the improved condition of the cylinders could not be charged to that alone. Vegetable oils do not thin out with heat as much as mineral oils, rapeseed oil losing its viscosity less than any other known oil, though commercial olive oil is not far behind it. Neither has found

an extended use in this country but have in parts of Europe they can be produced cheaply in comparison with mineral oils.

Personally, I don't like the use of vegetable or animal oils at high temperatures because of the liability of attack of the iron in cylinders and rings by the free fatty acids, but it is generally conceded that a small amount is beneficial rather than harmful.

Several years ago I made a canvas of the leading Diesel manufacturers in the middle west to determine what portion of the oil should be clarified, the object being to determine what size installation would be necessary. With one exception, they agreed that if the oil be taken from the bottom of the crank case, from 75 to 100 g. p. hr. would suffice. The one exception thought that all the oil should be clarified; in other words, the clarifier should be put on chain with the circulating system. As their largest engine circulated about 150 g. p. m., it would require an installation nearly as large as the engine itself.

In the sediment from Diesel oil, carbon is the principal constituent, together with some microscopic iron worn from the moving parts. The statement is often made that one oil "contains less carbon than another." This is a misstatement, as all mineral oils contain about 85 per cent carbon, the variation being very slight. Some oils carbonize more than others, but this can be determined in the laboratory. Of two oils with the same fire point the carbonization will be practically the same under similar operating conditions.

The same considerations apply, whether the oil be made from a pure paraffine base, a mixed base or a naphthene base. One of the best oils of my acquaintance is made from a mixed base, though the same refiner offers "pure Pennsylvania" if desired. Dr. Robert Grimshaw wrote once that the best guarantee that he ever found was his own experience. Every experienced engineer will agree with him. Frequently we try an oil that gives good service (and most of them do) and stay with it without trying further, believing with Hamlet that it is better to bear the ills we have than fly to others that we know not of.

St. Louis, Mo. L. R. BAKER.

Importance of Care in Defining Peaks

APPROACH of the season of maximum power plant loads in many public utility systems warrants brief consideration of peak definition in order that accurate records may be assured. Before the days of widespread interconnection, simple relationships between loads and plant facilities prevailed. Engineers differed as to the duration of peak periods in their stations, but if the log sheets specified the time involved in measuring load maxima and if indicating and recording instruments were regularly calibrated, little trouble arose. Load curves have been useful since the earliest days of electric power production and will continue to be so.

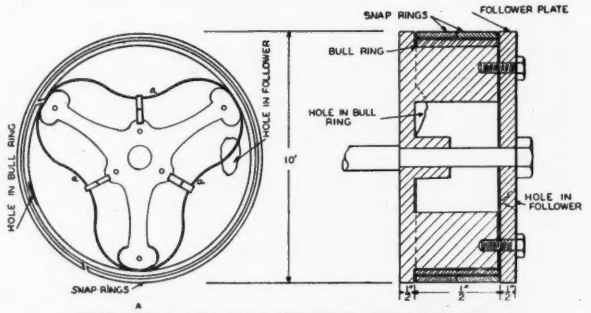
The advent of power interchange imposed an obligation upon operating engineers to use care in defining particular peaks. This obligation has not always been taken sufficiently to heart, even on large systems. Careless use of terms has crept into conversation and reports, just as many otherwise impeccable engineers misuse kilowatts in situations where kilowatt-hours are alone correct. The definition of peaks need not detain us; it is or should be a simple matter for the engineer always to bear in mind just what he is using in this connection. Local peaks and total loads including energy being received from other systems or delivered to them are not difficult to identify and separate, given proper instrumentation.

Different values for operating and engineering purposes reside in peaks obtained in different ways. A peak may be recorded as the observed momentary maximum at any time in the year; the average kilowatts spread over a stated interval as determined from watt-hour meter records; the highest reading on the day of heaviest output locally or in interchange set-up. Future engineering studies involving the capacity of equipment and lines are deeply affected by these definitions, since they bear so closely upon capital requirements. Similar considerations in the industrial generating plant, with its actual or potential interchange of surplus power with utilities or others of its kind justify precision of language and of records in running the gamut of peak definitions. Liberal policies in regard to the use of instruments pay in this field, and it is gratifying to see the standing such appropriations have attained in progressive concerns having much to do with the economical production and interchange of electricity.

Cambridge, Mass. H. S. KNOWLTON.

Emergency Pump Piston

SKETCHES A and B are to illustrate what we found in the steam end of a simplex pump used to pump water from a well and up into a tank on the seventh floor of the mill. The operators had been having trouble with this pump and could not seem to locate the difficulty, so the steamfitter was sent over to pull the piston and rod out. This piston was of the built-up type, 10 in. in diameter, with snap rings, bull ring and springs aaa, to keep a tension on the bull ring and the piston centered in the cylinder. A hole was worn through the



BUILT-UP PISTON WHICH GAVE TROUBLE.

follower plate, and another hole in the bull ring. These holes allowed the steam to blow through in sufficient quantity to reduce the pressure on the side the steam was being admitted, to a point where the pump could not operate.

We had a piece of round cast iron and instructed the machinist to turn up a solid piston, using the same snap rings, which is now operating until a new piston can be obtained. The main trouble with the make-shift piston is that it is too heavy for the stroke of the pump and seems to drag on the bottom of the cylinder when near the head end of the stroke, but as water must be had, when the mill is running, it will do until another and lighter one can be obtained.

Superior, Wis. FRED S. RUTLEDGE.

Keying Up Engines

ON PAGE 317 of the July issue, the question is asked about the position of a crank pin when keying up on a horizontal engine. The answer as given is correct only for keying up the crosshead pin. For keying up the crank pin end the crank pin should be near dead center. The reason for this is that the pin wears oval, the long axis being horizontal when on dead center.

Keyed up in this position the box is adjusted to the long diameter and runs free in all other positions. The cross head pin on the other hand wears oval with the long axis almost vertical so that it should be keyed up with the connection rod at its greatest angularity, i.e., with the crank pin at the top or bottom.

Chicago, Ill. H. J. GEBHARDT.

Centrifugal Pump Suction

MORE THAN half of all centrifugal pump troubles are on the suction side because there lies the weakness in this type of pump. It is quite a common occurence for an apparently well installed pump, every once in a while, to quit pumping for no apparent reason. Two prime causes, however, for a centrifugal pump loosing its priming are: (1) Air in the water. (2) Too much suction on the water before it touches the impeller blades.

The first thing to do when a pump starts acting up in this exasperating manner is to inspect the level of the water at the suction pipe. It sometimes happens that the pump suction will cause vortexes and these may be serious enough to pass sufficient air into the pump occasionally to break the suction. An addition of 2 or 3 ft. to the suction pipe will cure this.

The altitude of a pump above sea level makes a considerable difference in the maximum suction lift and the temperature of the water must also be taken into consideration. A 20-ft. suction lift is, roughly, the practical limit for cold water around sea level conditions and cold water means 60 deg. F. or less. Even with a suction as high as this the velocity of the water in the suction pipe must be kept low; somewhere around 10 ft. per sec. is a good figure to keep in mind but, of course, this will depend upon conditions.

Another important factor is to see that the internal resistance is low. This means that the pipe must be as direct and straight as possible. If there are a lot of fittings, valves and short turns then you have potential trouble and if, in due time, the pipe becomes dirty and deposits or corrosion forms then you have real trouble. The reason for this is that the pump will increase its suction to balance the increase in resistance and when the suction gets high enough the water will flash into low temperature steam. This sudden development of steam in the eye of the impeller immediately causes the suction to break and the pump pounds, races or does something equally annoying.

On high suctions there is another source of trouble and that is the actual heating of the water in the impeller due to friction; it may be only a few degrees but perhaps that is enough to reach the point where it will turn into steam under the suction present.

One of the greatest sources of trouble is the foot valve and strainer. These are always accumulating obstructions of various kinds such as leaves, branches, pieces of burlap, string, as well as unexpected things such as dead cats and old rubbers.

If the pump is at a high altitude then the practical suction lift is much less, furthermore, a temperature increase in the water is likely to be more troublesome. Even the barometric pressure is capable of causing trouble on high lifts for one engineer informed me that he uses his pump as a storm forecaster since it always breaks its suction ten minutes before a violent storm arrives. This gives him warning in time to get the windows closed, so he says.

Moline, Ill. GEO. P. PEARCE.

Preserving Concrete Foundations

OIL HAS a very harmful effect on concrete foundations, it causes them to rot and weaken and if continued the foundation will become useless. As the presence of oil cannot entirely be prevented, the concrete should be protected by suitable paint. The foundation should first be well cleaned and then a priming coat of a suitable cement paint applied. Use a primer especially made for concrete and cement surfaces, as ordinary paint is not satisfactory for use on these surfaces. As soon as the primer is dry a coat of oil resisting paint can be applied such as is commonly used for machinery. This will give the foundations effective protection from oil, at least so long as the paint coating remains continuous.

Herts, England W. E. WARNER.

Re-use of Lubricating Oil

IN THE OCTOBER issue, page 443, reference is made to the re-use of lubricating oil. For the engineer who has a prejudice against color, he can overcome that by filtering the reclaimed oil through fuller's earth, or if more convenient, by filtering the earth through the oil. In small units, the latter is preferable as it requires no equipment other than an old drum barrel or tank. Simply remove the head, pour in the dark oil, and add fuller's earth in proportion of one-half to one pound to the gallon, agitate for a few minutes with a paddle, then allow the mixture to stand. The fuller's earth as it settles to the bottom, carries the coloring matter with it. If sufficient earth is used, and the process repeated, the oil can be brought to a straw color or even pure white, by transmitted light. This refining pleases the eye only, as some oil is carried away by the earth, absorbed, as it were.

In my experience in selling oil reclaiming machines, the chief objection that I have found is that "The life has been burnt out of the oil." This is a mistake, as the weakest part of anything, gives away first. The "burnt smell" so noticeable in automobile crankcase oil, is not due to the combustion of the oil itself, but to aromatics from the gasoline that has passed by the pistons, the so-called dilution. This is removed by heating the oil either with live steam or direct heat. With turbine oil, Diesel oil or ammonia cylinder oil, this heating is not necessary, but in centrifuging it is an advantage in that it lowers the viscosity of the oil and increases the difference in gravity between the oil and the water added or present. For example, No. 10 Beaumé fuel oil has a gravity of 1.000 at 60 deg. F. while that of water at

60 deg. is only 0.999, on heating, the oil expands faster than water so that at 185 deg. F. the oil has fallen to 0.953 while the water is 0.968, thence, they expand about equally, so for separation purposes, nothing is gained at a higher temperature.

Of the various methods, re-refining has the objection that the compounding is lost, and any light distillates formed by cracking at high temperature, may be carried over. It is a messy job at the best, and very uncomfortable in warm weather. Centrifugal separation has none of these objections, and has the additional advantage that the water used, carries away any traces of acid that may be present; the installation and operating costs are much less, and floor space and attention are reduced to a minimum.

Several have asked just what is the composition of the coloring that is removed by the fuller's earth. So far as my investigations have been able to determine, it is colloidal carbon in graphitic form. At least, it assumes the graphitic form in presence of the earth. Bone black has a similar bleaching effect, but is more expensive, and I have had good success with china clay, both the English and the Philadelphia clay, as it is called.

In the choice of separators, it is convenient to get one that is self cleaning of the solids that may be present. In recovering automobile crankcase oil, this is important, as road dust is the principal contaminant. In a well designed machine, this is done by adding hot water to the oil feed, which carries the dirt along with it, so that the machine can be run indefinitely without cleaning.

St. Louis, Mo. L. R. BAKER.

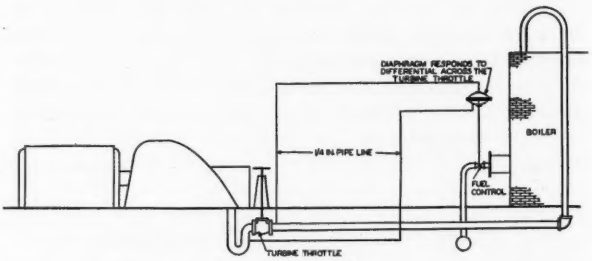
Variable Pressure Boiler Operation

IN THE SEPTEMBER ISSUE mention is made of operating the Benson boiler with variable pressure, that is, keeping the turbine throttle wide open and allowing the boiler pressure to swing with the load. This, it is observed, will reduce the load on the feed pump. But there are other advantages to be gained as well. There will be a reduction in the flue gas temperature, the wire drawing loss at the turbine steam chest will be practically eliminated and the loss due to leaks will be lessened.

For these reasons, this method of operation should be profitable even with the conventional type of boiler. I have estimated for a 600-lb. installation, with the turbines operating at an average of 75 per cent of the rated capacity the following gains: 1.25 per cent due to lower flue gas temperature and 0.75 per cent due to elimination of wire drawing and reduction in leaks, making a total of approximately 2 per cent.

The simplest case for this kind of operation is where the turbine is served by a single boiler which is either gas, oil or pulverized coal fired. Under these conditions, the equipment will respond to the load with the alacrity of an internal combustion engine. If the steam generating units are in multiple, the swing should be taken by one of them, the others operating at steady load, being stepped up or down periodically by hand to suit the load. The bulk coal fired boiler presents the most difficult example for the variable pressure operation. It is not likely that the response will be satisfactory for central station operation or even for the industrial plant. But this problem is not above solution and I am showing one way how this can be done.

The turbine throttle, instead of being open in a fixed position, will be under the usual control of the turbine governor and the stoker control will not be impelled by the change of load by way of the turbine speed, but will follow the turbine control. This is shown diagrammatically on the sketch. The stoker control valve is subject to the movement of the diaphragm, which in turn responds to the differential across the throttle. The valves can be adjusted to maintain any differential, but 25 pounds should be sufficient to off-set the boiler sluggishness.



METHOD OF OPERATING WITH VARIABLE BOILER PRESSURE

I have described the control of the fuel. The air, in this case as well as in other examples, can be regulated either by this primary control or can be made to tune with the change in fuel as in the typical combustion control, a number of which are on the market.

Existing steam plants can be readily changed to this method and the cost of installation will probably range between $500 and $5000, depending on the size.

Chicago, Ill. N. T. PEF.

Records of Maintenance

FINDING the repair and maintenance cost of every single item in the plant seems like a sizeable order for a good sized accounting department. Yet it is information that the plant engineering department is supposed to have in order to purchase equipment wisely and it is not so hard to get, if it is gone after in the right way. It is comparatively easy to keep track of the large pieces but the individual pumps, traps and motors appear to offer trouble. The following is a method that has been used successfully in at least two plants and is applicable with very little work to every piece of equipment in which one might be interested.

Give every piece of equipment a number. This does not have to be done all at once. When you come right down to it, there are comparatively few pieces in which you are interested and the repair crew can do the numbering in odd times with either a stencil or steel dies. It is best to assign a definite block of numbers to certain equipment such as 1 to 9, main generators; 10 to 19, condensers; 20 to 29, compressors; 100 to 199 pumps; 200 to 299, 300 to 399, motors, leaving room for new additions.

Each piece should have a card, 5 by 8 in. being a standard size and quite convenient. On this card should be the size, manufacturer, other name plate data, when purchased, and, where possible, the first cost, although

this is not always possible on old equipment. On the back should be space for a record of when it is in and out of service, as some pieces will spend most of their life in the storeroom as spares, so without this additional data the repair may seem unduly low.

Each time the inspector or operator finds equipment not working that should be noted but this should be on his report anyway so nothing additional is required. When the repair man works on a piece, its number should be noted on the work order, also on requisitions for repair material from the storeroom. These costs for labor and material should be transferred to the proper card. A couple of hundred cards will cover everything in the average plant and there will be perhaps 35 to 50 items to transfer each week to the cards. This gives a complete cost and operating record for only a little time each week.

Springfield, O. F PAUL.

Sand Blasting Requires Skill

A. S. JAMISON on page 398 of the September issue makes statements on the value of sand blasting in the power plant with which I do not agree. A sand blast should be used only by operators who are experienced in its operation. A return draft steam boiler or any other sheet steel receptacle can be permanently ruined by sand blasting in a short period if the work is improperly done.

I believe I am right in stating that more harm than good has been done in the ordinary steam power plant with the ordinary sand blast in the hands of inexperienced operators. I agree that all rust, grease and dirt must be removed from the interior of return steam boilers, sheet steel tanks, etc., before a steel preservative paint is applied, but a sand blast is not necessary to do that.

Toronto, Ont. JAMES E. NOBLE.

Budgeting Loads

LOAD FORECASTING may lose its importance in many an industrial power plant when routine service settles down into a long series of repetitive equipment duty cycles. In times like these it is another story. Amid the changes of these extraordinary days accurate estimates of hour-to-hour load variations even a few days ahead of their occurrence may be impossible in thousands of cases; but at least a private and confidential attempt to size up the future from the power production standpoint should be worth making.

This is done on large power systems with amazing economies in the handling of water and fuel plants tied together for the best regional service, despite the fickleness of weather conditions and other uncertain elements. In the local industrial power plant the engineer who tries to look ahead and budget the service of his equipment in accordance with the anticipated demands upon it is less likely to be caught napping in respect to economical service under the conditions arising than his brother of the throttle who drifts along with the load tide, floating a reasonable reserve on the line but without even a sketchy picture of expected service at hand as his plan of campaign.

Of course, all well-run plants provide an equipment service budget in one sense, but the current connotation of the term is expressed by a kind of strategic apprehension of demands which adds interest to the engineer's day when checked against logs if nothing else.

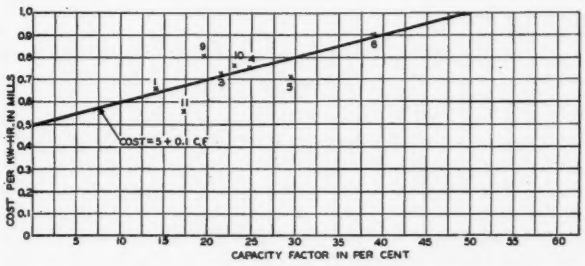
Cambridge, Mass. H. S. KNOWLTON.

Diesel Engine Costs

REFERRING to the article under the above title on page 181 in the April issue, the statement that "cost in mills per kilowatt-hour runs approximately equal to 5 plus 0.1C" seems incorrect to me. (C is equal to the capacity factor expressed in per cent.) From steam plant experience it would seem to me that the higher capacity factor should have the effect of lowering unit cost rather than increasing it as the application of the above equation would do.

A. B.

As mentioned in the article, costs mentioned refer only to the very definite group of stations operating under the same general supervision under somewhat the same conditions of operation and may not show costs comparable with Diesel engine stations in general. It may be that the greater importance of maintenance and repair in a Diesel plant gives a different cost characteristic than that of a steam plant. Fuel costs within a reasonable range of capacity factor remain practically constant whereas in a steam plant they increase very rapidly at lower capacity factors. On the other hand, lubrication and maintenance correspond almost directly to the hours of operation.



COSTS PLOTTED AS A FUNCTION OF CAPACITY FACTORS

Costs from which the formula 5 plus 0.1C was calculated are shown by the accompanying chart. It is possible that other engineers or operators have data which would throw light on this problem of cost variation. It is impossible to have a general formula which will hit all points, a formula is of course only a method of telling what might be expected under certain conditions.

AN EXHAUSTIVE survey is being made of research throughout the world on alloys of iron, alloy steel and alloy cast iron. The survey, about 70 per cent completed, was organized by the Engineering Foundation in coöperation with leading metal companies. About 4650 technical publications have been reviewed, and books will eventually be published containing all available information on alloys of iron and nickel, and on other alloys.

A NEW APPLICATION for wax emulsions is painting or spraying of stone, plaster, concrete, and similar surfaces. Outdoor weather-proofing and indoor brightness and washability are obtained. It has been in use for several years.—The Chemical Digest.

A. S. M. E. Annual Meeting December 4 to 8

AT THE AMERICAN Society of Mechanical Engineers' Annual Meeting, to be held in New York City, December 4 to 8, a three session Symposium on Heat Transfer of unusual interest and value has been arranged. In the symposium are papers contributed by the A.S.M.E. Divisions on Petroleum, Power, Iron and Steel, while the following societies are also contributing papers: American Society of Heating and Ventilating Engineers, American Society of Refrigeration Engineers and the American Society of Steel Treating, as follows:

Heat Transfer Rates on Condensing, Reboiling and Miscellaneous Heat Exchange Services, Max Higgin, Texas Co., New York.

Application of Fouling Factors in the Design of Heat Exchangers, E. N. Seider, Eng., Foster Wheeler Corp., New York.

Rates of Heat Transfer to the Radiant Heat Absorbing Section of Pipe Stills, Charles E. McCullough, Eng., Foster Wheeler Corp., New York.

Cleanliness Factor—Its Accuracy and Influence on the Other Commercial Factors for Surface Condensers, P. H. Hardie and W. S. Cooper, Brooklyn Edison Co., Brooklyn, N. Y.

The Effect of Angle of Emission on the Radiating Power of Various Oxidized Metal Surfaces (Report of Sub-Committee D. Heat Transmission National Research Council, R. E. Binkley, Lehigh University, Bethlehem, Pa.

Fuel Fired Heat Treating Furnace Transfer Rates, M. Mawhinney, Electric Furnace Co. (ASST paper).

Transfer of Heat in Electric Furnaces—General Electric Co. (ASST paper).

Discussion on Operating Data on Heat Transfer in Iron and Steel Plants by a group of discussors, ASME Iron & Steel Division.

Heat Transfer Rates in Refrigerating and Air Cooling Apparatus by W. J. King.

Heat Transfer Rates in Heating and Ventilating or Air Conditioning Practice by F. C. Houghten.

Heat Transfer in Economizers and Air Heaters by Henry Kreisinger.

Heat Transfer in Mercury Systems by W. T. Moore.

The Fuels Division is holding a session on Tuesday morning and presenting the following papers:

Report of Sub-Committee on Removal of Ash as Molten Slag from Powdered Coal by Percy Nicholls.

Burning Characteristics of Pulverized Fuels and Radiation from their Flames by R. A. Sherman.

On Wednesday morning the Industrial Power session will be held with the following papers presented:

Coöperation between Industrial and Public Utility Companies in the Generation of Steam and Electric Energy by H. D. Harkins.

Some Broader Aspects of Planning for Industrial Steam and Supply Projects by Vern E. Alden.

The Central Station session Thursday morning and afternoon, will include the following papers:

The Thermal Performance of the Detroit Turbine Using Steam at 1000 deg. F. by F. O. Ellenwood and W. A. Carter.

High Temperature Steam Experience at Detroit by P. W. Thompson.

Supersaturated Steam by John I. Yellott.

Leaving Velocity and Exhaust Loss in Steam Turbines by E. L. Robinson.

Among the other sessions of interest to the power field will be an Oil and Gas Power session on Wednesday morning, a Steam Tables Research session on Wednesday afternoon, a Boiler Feedwater session on Thursday afternoon, an Air Conditioning session on Thursday afternoon held jointly with the American Society of Refrigeration Engineers, and two Lubrication sessions on Wednesday. Design sessions that are also of interest are, two sessions on Tuesday of the Hydraulic Division on Water Measurement, one session on Fluid Meters and a session on Plasticity which includes a report by the Research Committee on Effect of Temperature on Properties of Metals.

The Air Conditioning Session—(ASRE and ASME session) will include the following papers:

Psychrometric Investigations and Data by Dr. F. G. Keyes ASRE.

Physiological Side of Air Conditioning by R. R. Sayres.

Noise Elimination and Air Motion by C. B. Graves.

Exposition of Chemical Industries

THE FOURTEENTH Exposition of Chemical Industries opens at Grand Central Palace in New York, December 4. From the industrial life of the nation as a whole, the chemical industries never separate. There is a power for industrial advance inherent in the exposition which nearly all appreciate.

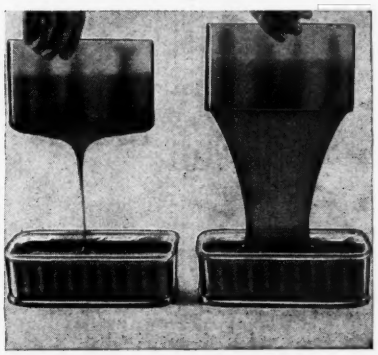
In broadest classification, visitors will see the most important materials in the present world, or the means by which they are produced or created. Mechanically, they will have opportunity to see materials changed in form, classified, transported, and packaged—involving again the latest means and materials, their uses, adaptations.

The exposition is classified broadly to include: raw materials, finished products, machinery and equipment, and educational exhibits. There will be sections devoted to materials handling equipment, and instruments of precision. Plastics will be the subject of a special group. Some of the phenomenal new applications of these materials will be displayed for the first time. The brewing industries section, a new feature this year, recalls the chemical background of the ancient industry now entering its American renaissance.

New Equipment

New Mineral Oils Process

An interesting new series of industrial lubricants which have unusually high film strength due to a special polymerization treatment were recently announced by the Research Staff of E. F. Houghton & Co., 240 W. Somerset St., Philadelphia, Pa. These new products, known as Sta-Put Lubricants, are made of pure mineral oil which is polymerized under carefully controlled heat and pressure. This treatment results in a complete rearrangement of the molecules of the oil without any change in its chemical content, thus producing a much closer bond between all of the molecules and a consequent increase in film strength from 40 per cent to 65 per cent. This is apparent in the illustration, both pictures show the

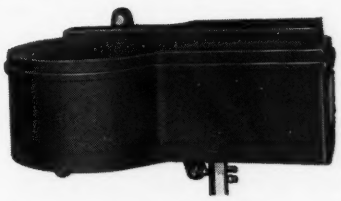


same oil, but that on the right has been treated by this process.

Sta-Put Lubricants are made in three series; the 300 series are liquid, ranging in consistency from light machine oils for high speed spindles to heavy oils for slow moving bearings and extremely high loads; the 400 series are made especially for gear lubrication, several grades having been developed for all types of gears to meet any condition of speed and load; the 500 series are of grease consistency and are made for screw-down grease cups or automatic grease lubrication systems.

Draft Regulator

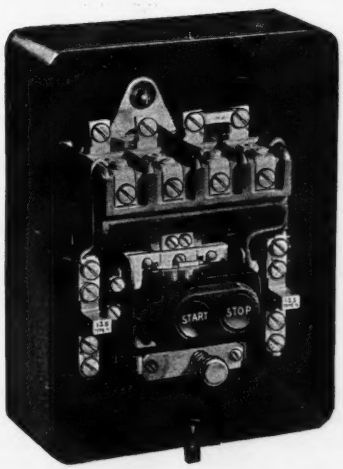
NEED FOR an accurate and reliable means for draft control for average sized boiler plants prompted the Carrick Engineering Co., Box 299, Michigan City, Ind., to develop the Carrick Type HF1 hydraulic draft regulator. This is the same type control used in its combustion control system for larger boilers. In addition to the control of the combustion chamber draft the regulator can also be used to control fan speed, or ventilating system pressures or drafts.



The fundamental design of the regulator is that of a beam scale. Draft is automatically weighed until the amount of draft for which it has been set is secured. This draft is then automatically and accurately maintained and balanced by the regulator. Diaphragms are eliminated and a bell immersed in an oil seal is the means used to measure the draft.

A New, Automatic, Across-the-Line Switch

NEW SOLENOID-OPERATED across-the-line starting switch has just been announced by the Allen-Bradley Co., 1311 S. First St., Milwaukee, Wis. It is rated at 5 hp., 220 v.; 7½ hp., 440-550 v. for polyphase motors, and up to 1½ hp., 110 v.; 3 hp., 220 v. for single phase self-starting motors, and is made in 3 forms: Form 1, with start and stop push buttons; Form 2, without push buttons, for thermostat or remote pilot control; Form 3, with 2-way Hand-Automatic switch for "try-out" control installations.



A distinctive feature is its small cabinet dimensions, obtained by substantially reducing the size of the switching mechanism. Adequate wiring space is therefore provided in the cabinet. Double-break silver alloy contacts have reduced contact maintenance and increased contact life. A new patented arc hood suppresses the arc so completely that locked rotor currents of motors several times the rating of the switch can be broken without flash-over or distress. There are no flexible jumpers, bulky arc barriers, or pivoted bearings.

Two Allen-Bradley Resisto-Therm Relays with interchangeable thermal elements provide overload protection. The arc hood and switch contacts are self-insulated. All switch parts are mounted on a metal back plate. The switching units can be mounted singly or in gangs on machine frames or in metal cabinets without further insulation. Rubber grommets between switch mechanism and base plate give a full floating mounting which prevents the slightest switch noise from being transmitted to and amplified by the starter cabinet. Machine vibrations, therefore, cannot be transmitted back to the switch and interfere with its operation.

New Mercury-Switch Thermometer Controller

USE OF MERCURY switches to eliminate open make-and-break contacts controlled by the pen arm, is a feature of a new Automatic Control Thermometer announced by The Brown Instrument Co., Philadelphia, Pa. In this new controller, every six seconds a motor-driven control table determines the location of the pen on the chart in reference to the control setting, and tilts the mercury switch from one side to the other if the temperature has changed. With this system, the measuring mechanism is free to position itself, unhampered by the control mechanism. There is no excess weight on the pen, no distortion of the pen arm, no restriction of pen movement. The making

of control contacts is not dependent upon friction, because the switch is positioned with a positive action by the electric motor. Contacts are unaffected by vibration because the mercury switch is mechanically locked in place until a different position is required. Corrosion and dirty contacts are eliminated as the switch is sealed in glass. These mercury switches have capacities up to 15 amp. at 110 v., thus eliminating external relays in most applications.

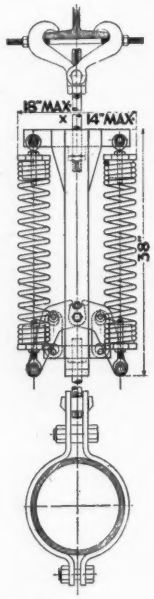
This control mechanism is adaptable to one-, two-, or three-contact control (or signalling) systems. In a two-record controller, each control mechanism can control a separate device, each may be used independently of the other, and each has its own control index. This new Brown controller is also supplied as a time-temperature cycle controller. A transparent cam placed over the chart is used to shift the control index in relation to time. As the cam rotates with the chart, the control point is moved to new positions, depending upon the shape of the cam. A different cycle of control operations can be obtained by simply cutting a new cam.

All models of this controller are furnished in circular 10- or 14-in. dust-proof cases, and offer all the outstanding features of the new Brown Recording Thermometer and Pressure Gage, introduced several months ago. This controller is equally adaptable for control of pressure, liquid level, and similar factors, as well as temperature. Catalog No. 6702, completely describing this new line of controllers, has just been issued.

Pipe Hanger

ONE GREAT PROBLEM of pipe suspension is to afford the pipe line constant and uniform support at all items so that vertical movements will not induce the non-axial stresses that strain joints and cause their failure. The Genspring Constant-Support Pipe Hanger recently put on the market by the General Spring Corporation, 11 West 42nd Street, New York City, is designed to furnish pipe lines with this constant support throughout a two-inch range of vertical movement. The standard model is for loads between 500 and 7000 lb. but greater loads and movement ranges can be provided for on special order.

The hanger weighs about 160 lb. and has the following maximum dimensions: height, 38 in.; width, 18 in.; thickness, 14 in. The use of interchangeable springs of different capacities permits the wide range of possible loads given above.



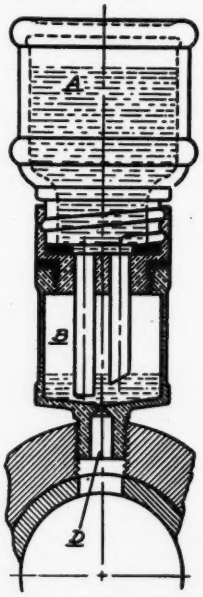
Springs are adjustable to plus-or-minus 15 per cent of rated capacity at any time before or after installation.

Electric Contact Gages

HAYS CORP., Michigan City, Ind., announce a complete line of compact electric contact gages for draft, pressure and differential draft or pressure in ranges between 0.1 in. water and 100 in. water and employing the Hays dry type actuating unit. These gages are offered for either high or low contact service or for both, equipped with closed mercury switches or open contacts, depending on service conditions. The bull's-eye signal light, as illustrated, is optional.

Speedway Automatic Oilers

SPEEDWAY MANUFACTURING CO., Cicero, Illinois, announce a line of automatic Speedway Oilers. These new oilers are of two types: Constant Level and Thermal. The constant level oilers are designed especially for use on electric motor bearings and other reservoir bearings with oil-ring, packing, or ball or roller bearings where oil in the reservoir should be maintained at a determined level. This is done by means of a tube which permits air to enter and oil to flow from the reservoir when the level of oil in bearing



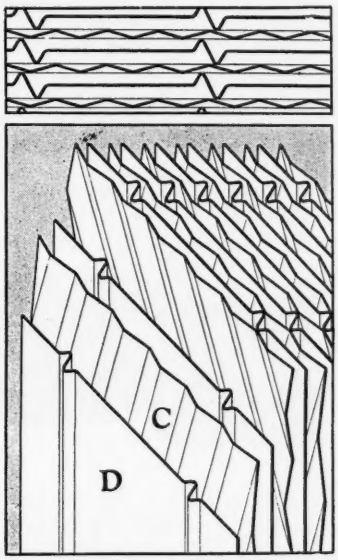
reservoir drops below the fixed and proper level—automatically stopping the flow of oil when this level is attained.

Thermal oilers, illustrated here, designed for use on sleeve bearings of the open type, are operated wholly by change in the bearing temperature. Heat in the bearing causes an expansion of the air in the thermal chamber, forcing small quantities of oil to the bearing. Both types have a visible oil supply.

New Heater Surface

NEW TYPE of heating surface is now used in Ljungstrom Air Preheaters for further reduction in preheater volume and weight and in fan power requirement for given delivery, according to the manufacturers, the Air Preheater Corp., now affiliated with the Superheater Co., 60 E. 42d St., New York, N. Y. In this latest design, which has now been adopted as the standard, the crimped sheets C have their undulations sloping at 30 deg.

to the path of fluid travel and in opposite directions in alternate sheets, and the corrugated sheets have been replaced by flat sheets D, having longitudinal spacing ribs. These sheets form wide longitudinal passages, and their ribs are proportioned to keep the crimped plates far enough apart to give the most desirable sectional area to the passages.



A study of the illustration reveals extreme openness of the passages combined with turbulence from flow over the undulations in the crimped sheets, and accompanied by secondary whirl from inclination of the undulations. The whirl prevents the gas and air from stratifying, and forces all parts of each fluid stream into close contact with the metal.

As heating surface of the new design is interchangeable with that of older design, the capacity and recovery of existing Ljungstrom Preheaters can be substantially increased by substituting the new heating surface.

Weston Photo-Electric Kit

THE WESTON ELECTRICAL INSTRUMENT Corporation, 614 Frelinghuysen Avenue, Newark, N. J., has just announced a new, inexpensive Photronic Control Kit which is being marketed especially for those engineers and manufacturers who prefer to do their own experimenting with photo-electric control for mechanical equipment, operations, and for processes of various kinds. The kit contains all the equipment necessary for the engineer to start immediate experiments, together with diagrams of connections. The equipment can be used as a smoke detector, burglar alarm, turbidity detector, door opener, counter for all classes of service, safety device on machines, etc.

Included in the kit is the Weston photronic cell which has the peculiar faculty of transforming light energy directly into electrical energy and operates the Weston relays without the use of any auxiliary apparatus or batteries. As far as is known, the cell has unlimited life, and the output is constant. Its spectral response is about the same as the human eye, so that it is extremely sensitive to color changes and is finding wide application wherever processes must be controlled by changes in color.

Rigid Wiring Suspension

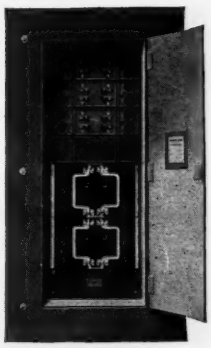
SQUARE-DUCT, Square D's modern rigid suspension method for wiring, consists of standard length ducts, such as shown in the accompanying reproduction, with full length hinged covers and various fittings to meet all conditions of installation so that a flexible wiring system, instantly accessible at any point, is provided. Closely spaced knockout holes permit conduit or armored cable con-

nections at any point of the system without the time and expense of running the individual circuits to the distribution center. Square-Duct is built in two sizes: 2½ by 2½ in. and 4 in. by 4 in. The two sizes may be combined in a single system, the connections being made at any convenient point.

Saflex, Jr., Panel Boards

SQUARE D SAFLEX, JR., line of safety convertible power panels are ideally suitable for power and feeder installations where circuits do not exceed 100 amp., 250 v., according to the engineering department of the Square D Co., Detroit, Mich.

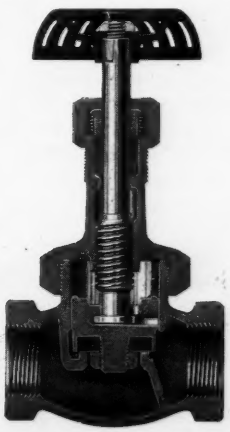
These panels, obtainable for either flush or surface mounting, are mounted in cabinets only 6 in. deep and 19 in. wide. 30 and 60 amp. circuits are available in either twin or



single units, while 100 amp. circuits are manufactured in single units only. They are completely dead-front, convertible, and the individual circuits can be locked in either the on or off position. Unit doors are opened and closed with ease by means of cam action handles in spite of the high pressure contacts employed for positive contact and reduced heating.

Lunkenheimer Non-Metallic Disc Valve

THE LUNKENHEIMER Co. has just announced Fig. 123 "N-M-D," a non-metallic disc bronze valve suitable for 150 lb. steam pressure and 300 lb. gas-liquid pressure. Fig. 123, illustrated here, has a non-heat malleable iron hand-wheel and an extra deep stuffing box that

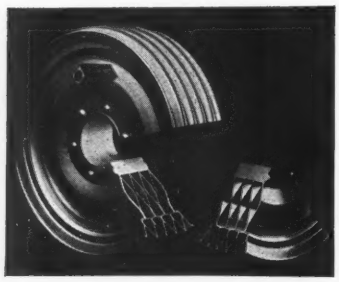


holds a generous supply of packing. Stem is of rolled bronze, unusually heavy. Long threads are fully engaged with bonnet thread when valve is closed. Shoulder above the stem thread seats tightly against bottom of stuffing box, making the valve repackable under pressure.

Three basic types are offered—steam, hot water and cold water, gas and air, which are regularly available in several designs—globe, angle, horizontal and angle check, spring check for compressor service and quick operating.

Texsteel Texrope Drives

ALLIS-CHALMERS Texrope V-belt drive with one or both sheaves made of Texsteel are now available from ¼ to 15 hp. Texsteel sheaves are of grid type construction, well balanced,



light in weight and practically indestructible, with accurately formed, heavy gage steel sections, electrically welded at web and rim and are attractively finished in aluminum. Outer rims are rolled for protection and strength. Integral bushings or solid bored hubs are standard.

New Multi-Range Portable Current Transformer

A MULTI-RANGE portable current transformer has recently been placed on the market by the Standard Transformer Co. of Warren, Ohio. This transformer is contained in a molded bakelite case, is 10 va. capacity, insulated for 10,000 v. and is suitable for accurate metering service of any type of current

measurement within the range of the insulation.

The transformer has a wound primary which covers a current range of 5/5, 10/5, 20/5, 50/5 and 100/5 amp. and is built so that the inserted primary gives a maximum range of 800/5 amp. The approximate size of the transformer is 3 by 7⅛ by 9¼ in. Weight approximately 9½ lb. The unit is equipped with carrying strap and is light and compact.

New Silencer

ONE OF THE latest products of the Acoustic Division of the Burgess Battery Co., Madison, Wis., is a silencing manifold for either exhaust or intake, in which are incorporated the silencing effects ordinarily performed by a separate muffler.

Sound absorption is accomplished by means of a porous sound absorbent material faced with a perforated metal lining through which the gases pass. This lining is perforated in a way which allows the sound to penetrate into the porous absorbent material freely, but does not appreciably impede the flow of the gases.

Lunkenheimer Loose Pulley Oiler

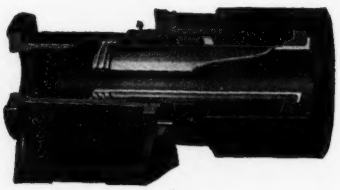
UNDER THE name of Vosta oiler, the Lunkenheimer Co., Cincinnati, O., has developed a device for lubricating loose pulleys. It consists of a glass body and bronze base in which a tube is mounted extending to near the top of the bottle.

As the pulley revolves the oil is thrown outward by centrifugal force. Feeding is governed by the thermal principle—periodic expansion and contraction of air within the reservoir due to temperature changes. To provide this air space, the oiler should not be filled more than three quarters full.

Adsco Expansion Joint

PATENT has been granted by the United States Patent Office to Robert Hall, President, American District Steam Co., on a new design of slip type expansion joint. Patent has been assigned to the American District Steam Co., North Tonawanda, N. Y. Through an adaptation of the piston ring idea, similar to that used in gas engines, the line pressure in steam or other piping equipped with the new piston ring expansion joint is retarded in reaching the stuffing box. This permits of completely repacking the joint, if necessary, while the line is operating under full pressure.

A small relief connection with suitable valve is made into the body



of the joint between the piston ring head and the stuffing box so that the pressure which may have built up in that area can be quickly relieved, if and when new packing is required. The piston ring arrangement prevents the fluid in the line from escaping during any such temporary period, thus permitting of repacking the joint in service.

The guide head in which the piston rings are retained also serves as an internal guide operating in the machined cylinder of the body, thus preventing any lateral distortion of the slip, and the stop ring prevents the slip from pulling out of the body. The new joint is now being placed on the market for all operating pressures and in all pipe sizes.

AMERICAN SOCIETY for Testing Materials, 1315 Spruce St., Philadelphia, Pa., has just reprinted the annual report of Committee A5 on Corrosion of Iron and Steel. This is a 36 page, paper bound volume with 3 large folded plates. Copies can be obtained from the headquarters of the society at $0.50 each. The reprint includes detailed records of extensive tests sponsored by the committee and presents the result of various inspections made during the past year on test specimens.

BURNING OF LIQUID and Gaseous Fuels is a 13-page report, Publication No. A4, published by the Edison Electric Institute, 420 Lexington Ave., New York City. Among other data this report includes rates of furnace heat liberation; excess air; gas metering; comparison of fuels; variation of fuels and details of operation of various units. Price $0.30 to members and their employes; $0.75 to nonmembers in U. S. A.

Beginning Made on Columbia River Project

A BEGINNING has been made on the Grand Coulee project on the Columbia River in the State of Washington, by the authorization of a preliminary permit to the Columbia Basin Commission, which represents the State of Washington. This project involves the expenditure of $63,000,000 and has already been approved for consideration and development by the administration.

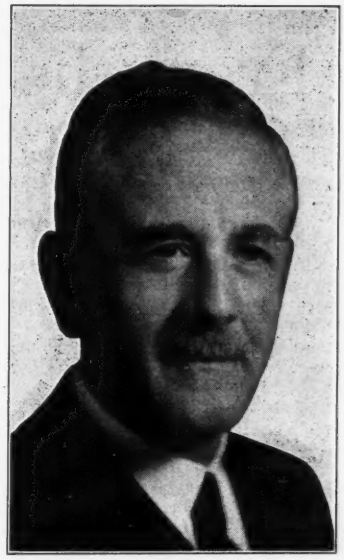
This project will provide for the construction of a dam across the Columbia River at a point about 600 mi. above its mouth. The project will be projected in two separate stages, the first of which will include the construction of a dam to the height of 150 ft. and the installation at the dam of electric power units having a capacity of 700,000 hp. The second stage will increase the height of the dam to 370 ft. and increase the power installation to 2,100,000 hp.

The authorization of this preliminary permit enables the Columbia Basin Commission to proceed with the necessary investigations and provide a definite layout and project to show the Federal Power Commission what it proposes to do and accomplish, and to present detailed plans within 3 yr. from the date of the license. After this is done, the Commission will hear everyone concerned, and if satisfied will grant a permit for the construction of the project. It is therefore safe to state that the actual construction on the project will not begin for at least a year.

Jacob M. Spitzglass

JACOB M. SPITZGLASS, of the Republic Flow Meters Co., died Oct. 1 of arterial thrombosis at the Meyer House Hospital, Chicago. Born in Russia in 1869 he came to America in 1904 and although handicapped by a limited education, lack of English and the necessity of supporting a wife and two children, he entered Armour Institute of Technology and took his first degree at the age of 40, his second four years later.

Shortly after this he became associated with the Republic Flow Meters Co. as vice president and chief consulting engineer and developed the electric flow meter which replaced the original Gebhardt meter manufactured by the company. More recently he became interested in the development of a domestic house heating and industrial gas burner.



Mr. Spitzglass was active in the A. S. M. E. and served as secretary of the research committee on fluid metering. Perhaps his best known contribution to fluid flow advancement was his well known A. S. M. E. paper, Orifice Coefficients, presented before the A. S. M. E. in 1922. In 1921 he was awarded the Longstreth Medal by the Franklin Institute for his work on fluid measurements.

Charles Piez

CHARLES PIEZ, who with Charles M. Schwab, directed the wartime work of the Emergency Fleet Corp., died October 2 at the Garfield Hospital, Washington, D. C. Mr. Piez was Chairman of the Board of Link-Belt Co., Chicago.

Mr. Piez was a past President of the American Society of Mechanical Engineers. He served twice as President of the Illinois Manufacturers' Association. The deceased was born in Germany 67 yr. ago. While pneumonia was the direct cause of his death, his health had been failing for the past 5 yr., and since February, 1932, he had been wholly inactive in business. Last May Mr. Piez moved from Chicago to Washington, where he made his home at the Shoreham Hotel. He is survived by his widow, Laura Sadler Piez, formerly of Laurel, Md.

Largely as a result of his fame as an organizer and manager of industry, Mr. Piez was selected by Edward N. Hurley, then Chairman of the U. S. Shipping Board, in November, 1917, to be Vice-President and General Manager of the Emergency Fleet Corp., to carry out the nation's shipbuilding program. As the chief executive of this mammoth enterprise, and later succeeding Mr. Schwab as Director General, Mr. Piez advised upon and directed the expenditure of three billion dollars. He had control over 600,000 persons employed in the shipyards and fabricating plants, and in industries furnishing supplies to the yards.

Mr. Piez resigned on May 1, 1919, as Director General, to return to his former business. He continued as President of the Link-Belt Co. until 1924, when he became Chairman of the Board, and remained as chief executive until February, 1932. Mr. Piez was a Director of the Drexel State Bank of Chicago; Director, Illinois Bell Telephone Co.; a member of the Executive Committee of the Museum of Science and Industry founded by Julius Rosenwald. He received the Honorary Degree of Doctor of Commercial Science, New York University.

Columbia University gave Mr. Piez his technical education as a mining engineer at the School of Mines. Immediately after he was graduated in 1889, he entered the employ of the Link-Belt Engineering Co., in Philadelphia, as an engineer-draftsman. After he had attained to the position of Chief Engineer and General Manager of the Philadelphia Works of that concern, seventeen years later (in 1906), he was elected President of a consolidated organization of the three related companies, the Link-Belt Machinery Co., Chicago, the Ewart Manufacturing Co., Indianapolis, and the Link-Belt Engineering Co., Philadelphia.

News From the Field

PERCY S. YOUNG, vice-president in charge of finance, Public Service Corp. of New Jersey and subsidiary companies, was elected vice-president of the American Gas Association at the fifteenth annual convention of the association in Chicago, September 27. Mr. Young has long been active in the work of the Association and was a member of its board of directors.

SARCO CO., INC., New York, has appointed H. C. Freese, 811 East Armour Blvd., Kansas City, Mo., and Colby Equipment Co., 136 N. Delaware Ave., Indianapolis, Ind., as representatives in their respective territories.

ARTHUR J. KENNEY was recently appointed chief engineer at Little Falls Laundry, Little Falls, N. J. Mr. Kenney was formerly connected with Combustion Engineering Corp. and Babcock & Wilcox Co. When additional installations are completed, this plant will have one of the largest laundry power houses in the country.

BRANCH OFFICES of the General Electric Contracts Corp. have been opened in Chicago, Philadelphia, Cleveland and Schenectady. The purpose of this corporation, which started operations in its main office, 573 Lexington Ave., New York, on Jan. 1, 1933, is to extend to customers of the General Electric Co. in the home appliance field, through the regular dealers, a complete financing service. The officers of the General Electric Contracts Corp. are: George F. Mosher, president; R. E. Sincerbox, treasurer; A. D. Marshall, secretary, and J. H. Strube, auditor.

H. W. WILSON was recently appointed chief engineer at I. T. Williams Co., Carteret, N. J., succeeding Mr. C. Johnson.

H. H. BLAKESLEE, formerly assistant manager of the New Orleans office of the General Electric Co., has been appointed manager of the office to succeed B. Willard, who is retiring on pension. J. W. Hicklin, heretofore manager of the Richmond office of the company, has been made manager of the Baltimore office, succeeding G. H. Gilbert. H. V. Whitney, formerly in charge of the general sales, territorial and building equipment sections of the industrial department in the Atlantic division of the company, has been appointed manager of the Richmond office, a sub-office of the Baltimore office.

NORTHERN EQUIPMENT CO., Erie, Pa., announces the appointment of The C. J. Gaskell Co. as Memphis, Tenn., representatives for Copes feedwater regulators, differential valves, pump governors and allied equipment. Mr. Gaskell had been associated with the former Copes representatives in the Memphis territory for a number of years,

THE FALK CORP., Milwaukee, Wis., announces the appointment of T. F. Scannell, who has been its St. Louis representative for several years, to the Dallas, Tex., territory, having charge of oil field sales in Texas and Oklahoma. His office will be located at 1410 Magnolia Building. The St. Louis territory has been taken over by Fitch S. Bosworth, 5475 Cabanne Avenue, who will represent the Falk Corp. on its entire line of products.

E. F. "GENE" LENOIR has recently been appointed representative for The Louis Allis Co., with headquarters at Allentown, Pa.

CHAS. F. NORTON, former vice-president and general manager of the Howell Electric Motors Co., has recently become associated with The Louis Allis Co., Milwaukee, in an executive sales capacity.

THE BEAUMONT BIRCH CO. announces the appointment of the Ernest E. Lee Co., 115 S. Dearborn St., Chicago, as representatives in the Chicago territory, covering the sale of coal, coke and ash-handling equipment for power plants and gas works.

ON SEPTEMBER 12, 1933, The Superheater Co., New York, acquired an interest in and assumed the management of The Air Preheater Corp., Wellsville, N. Y., manufacturers of Ljungstrom air preheaters. The Air Preheater Corp. retains its corporate identity under new management, and will continue the manufacture of its products at its Wellsville plant. H. S. Colby will remain in the organization as vice-president. Its executive offices will be consolidated with those of The Superheater Co. at 60 East 42nd Street, New York. Air Preheater sales activities will be coördinated with the Industrial Department of The Superheater Co., with headquarters at that address, and of which William T. Conlon has lately been made manager.

The new officers of The Air Preheater Corp. are as follows: F. A. Schaff, president, H. S. Colby, vice-president, M. Schiller, vice-president and treasurer, T. F. Morris, secretary and assistant treasurer, H. S. Marshall, assistant secretary and assistant treasurer. The directors are George L. Bourne, chairman, W. L. Batt, H. S. Colby, R. M. Gates, F. A. Schaff and M. Schiller.

THE LICENSE for the construction of the dam and hydroelectric project on the Little River, by the City of Bradford, Virginia, has been issued by the Federal Power Commission. The Reconstruction Finance Corporation is expected to finance it under a public works loan, to the amount of $129,000.

For the Engineer's Library

PULVERIZED FUEL is a 39-page booklet, Publication No. A6, published by the Edison Electric Institute, 420 Lexington Ave., New York City. This report includes the installation and operating data from 43 operating companies covering 181 boiler units and shows a trend in favor of direct firing as against the bin system. Other subjects covered are coal feed interruptions; maintenance and operation; performance; furnace bottoms and corrosion. Price $0.75 to members and their employes; $1.85 to non-members in U. S. A.

STOKER EQUIPMENT and Furnaces is a 22-page report, Publication No. A7, published by the Edison Electric Institute, 420 Lexington Ave., New York City. Report contains information on recently installed stokers, fans, air compressors and combustion control with particular reference paid to maintenance problems and operating results. Data are given of furnace temperatures and operating conditions for bare water walls in comparison with air-cooled furnaces and refractory faced water-cooled walls. Air preheater corrosion and fouling problems are discussed at considerable length. Price $0.60 to members and their employes; $1.50 to non-members in U. S. A.

MANUAL ON PRESENTATION of data has been published by the American Society for Testing Materials, 1315 Spruce Street, Philadelphia, Pa. The manual was prepared by a committee of engineers, who are at the same time statistical experts, to correlate and make available in convenient form some of the principles of efficient presentation of data. It discusses the application of statistical methods to the problems of condensing information contained in a set of observations and presenting the essential information in a concise form more readily interpretable than the unorganized mass of original data.

There are given in the manual critical comments on various methods used in presenting data, a discussion of what relevant information should accompany the data and the committee's recommendations for data presentation. The book comprises 45 pages, and heavy paper cover copies can be obtained at $0.50 from the society headquarters.

PERFORMANCE OF PROPELLER FANS. By A. I. Brown. Published by the Engineering Experiment Station, Ohio State University, Columbus, O., as Bulletin No. 77. Size 6 by 9 in., paper, 33 pp. Price $0.25 (limited number available for free distribution).

Commercial ratings of propeller fans, particularly of the airplane type, when analyzed on the basis of mechanical efficiency, show many published values to be inconsistent and unreliable due in many cases to inaccurate methods of testing. Tests were conducted by the author in accordance with a standard code on 50 or more propeller fans of various makes and designs. Performance characteristics of fans of the airplane propeller type were found to be quite different from those of other designs and to be greatly influenced by the construction of the fan ring. The results of this investigation for 21 of the tests are given in the bulletin with tables and graphs included to show the theoretical power requirement for fans of various sizes and capacities.

THE COPES CATALOG of Flow, Level and Pressure Controls has just been released by Northern Equipment Co., Erie, Pa. The units described in this catalog are the result of designs made for special purposes but employ several devices developed for use in the feedwater regulation system.

THE EDWARD VALVE & MFG. CO., Inc., East Chicago, Indiana, has just issued Section L of Catalog No. 11 showing its complete line of Ferac (high strength iron) valves, including non-return, globe and angle stop, check and blow-off valves. This

line of valves, for service in steam plants operating at pressures up to 250 lb., is completely described with full specifications, dimensions and list prices.

FARREL-BIRMINGHAM Co., Inc., Buffalo, N. Y., describes in its bulletin No. 437 the Farrel Gearflex couplings, giving numerous illustrations, diagrams and tables of ratings, dimensions, weights and list prices, as well as descriptive matter and information for ordering these couplings.

MONASH-YOUNKER Co., Inc., describes in a bulletin recently issued the Monash thermostatic traps and elements which are used extensively in heating systems.

DEARBORN CHEMICAL Co., Chicago, is distributing a booklet entitled "Dearborn Water Treat Units and Testing Equipment," which describes the complete series of units for introducing Dearborn treatment to boiler feedwaters and for testing boiler waters in railway and sanitary service.

MCBURNEY STOKER & EQUIPMENT Co., Atlanta, Ga., describes a new automatic stoker built to serve boilers ranging in capacity from 20 to 250 hp., in a folder recently published.

COVERING CONVECTOFIN built-in heaters, a bulletin of list prices has just been published by the Commodore Heaters Corp., New York City. Drawings of seven typical installation types are shown so that anyone can readily determine in advance what heater costs will be for any type and any size.

A FOLDER has just been issued by the Ingersoll Steel & Disc Co., division of the Borg-Warner Corp., Chicago, illustrating many applications of IngOclad stainless clad steel. The text and descriptive matter in the folder deal with the application of IngOclad in almost every phase of the metal working and process industries where the corrosion resistance and sanitation of stainless steel is desired, combined with low cost of the fabricated product.

THE EDGE MOOR IRON Co., Edge Moor, Del., announces that it has acquired the exclusive right under the Irwin patents, to manufacture and distribute the Irwin automatic gas fired boilers for all purposes including industrial, commercial and domestic use. George H. Irwin has been appointed chief engineer of the Edge Moor-Irwin Gas Boiler Division, with Frank S. Luney as his assistant.

STEAM AND COMBUSTION Co., Chicago, Ill., has just published the SteCom World's Fair Souvenir bulletin which contains articles on the use of SteCom boilers and burners in exhibits at A Century of Progress Exposition.

NORTHERN EQUIPMENT Co., Erie, Pa., is distributing a new catalog on the Copes feedwater regulators and allied equipment which presents in an attractive way descriptions of this equipment, emphasizing important details and describing the operation of these regulators and the results obtained in power plants.

ENGINEERING DATA on installation, insulation and pressure loss through welding fittings of all sizes and shapes for power service are included in Price List 404 recently published by Tube-Turns, Inc., Louisville, Ky.

A REVISED 12-PAGE circular describing and illustrating gas electric sets for every application has been issued by the Westinghouse Electric and Manufacturing Company. The publication describes the outstanding features and applications of these sets ranging in sizes from 800 watts to 100 kv-a. The sets are applicable wherever auxiliary or standby power is needed and are especially designed for theaters, hotels, schools, radio stations, airports, construction and mining companies, and building owners and architects.

LINK-BELT models K-38, 44, and 55 are covered in three attractively illustrated eight-page folders recently issued by Link-Belt Co., Chicago, on crawler-mounted shovel, crane and dragline equipment. Lifting capacities, clearance diagrams and other data are given.

A NEW FLUID VALVE is the subject of a four-page leaflet, No. 20592, recently issued by the Westinghouse Electric and Manufacturing Company. Large or small volumes of compressed air, liquid mediums such as gasoline, water, oil, and gas can be controlled accurately by the use of this electrically operated check valve.

BROWN INSTRUMENT Co.'s indicating, recording and controlling instruments for the measurement of temperature, flow, per cent CO_2, pressure, speed and liquid level are made the subject of a folder recently issued by the company under the title, Hundreds of Dollars Saved by Analyzing Chart Records.

UNITED STATES HOFFMAN MACHINERY CORP., New York City, devotes its catalog No. A-152 to multistage centrifugal blowers and compressors manufactured by this company. The bulletin contains a description of the compressor, specifications and general instruction, a list of applications and curves of performance characteristics.

IN A BULLETIN designated as No. 57, the Pure Oil Co., Chicago, Ill., presents a rather comprehensive treatise on lubrication of bearings, all types of modern bearings being dealt with and the characteristics of various grades of lubricants are discussed.

DIAMOND CHAIN & MFG. Co., Indianapolis, Ind., is distributing its new catalog 583 dealing with Diamond chains and sprockets. The catalog contains complete information on where to use these chains and how to select proper size sprockets, also calculations, formulas and tables for determining chain lengths.

HARDINGE Co., INC., York, Pa., describes its constant weight feeder in bulletin No. 33B. Diagramatic sketches show clearly the principle of operation and general dimensions of various sizes, applications, capacity tables and photographs of installations are also given.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC.,

required by the Act of Congress of August 24, 1912, of Power Plant Engineering, published monthly at Chicago, Illinois, for October 1, 1933.

State of Illinois, } ss.
County of Cook, }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared E. R. Shaw, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Power Plant Engineering and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Technical Publishing Co., Chicago, Ill.

Editor, Arthur L. Rice, Chicago, Ill.

Managing Editor, R. E. Turner, Chicago, Ill.

Business Manager, E. R. Shaw, Chicago, Ill.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

Technical Publishing Co., Chicago, Ill.
E. R. Shaw, Chicago, Ill.
Arthur L. Rice, Chicago, Ill.
K. L. Rice, Chicago, Ill.
Madge W. Rice, Wilmette, Ill.
Chas. S. Clarke, Chicago, Ill.
R. E. Turner, Chicago, Ill.
A. W. Kramer, Chicago, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)

There are none.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is ..... (This information is required from daily publications only.)

TECHNICAL PUBLISHING CO.

E. R. SHAW,
Business Manager.

Sworn to and subscribed before me this 26th day of September, 1933.

[Seal.] EDDIE H. KAHL,
Notary Public.

(My commission expires March 21, 1936.)

Power Plant Construction News

Ark., Huttig—Union Saw Mills Co., Huttig, operated by Frost Lumber Co., Shreveport, La., Plans installation of power equipment in connection with rebuilding of portion of mill, recently destroyed by fire. New boiler house is proposed. Loss over $150,000.

Calif., Healdsburg—Geysers Development Co., 417 South Hill Street, Los Angeles, Calif., R. E. Bering, president, plans construction of new electric light and power plant at Healdsburg, with initial installation to include two 1000 kv-a. turbo-generator units and auxiliary equipment. Natural gas will be used as fuel. Entire project will cost over $80,000.

Calif., Montebello—Board of City Trustees is arranging early construction of a new municipal electric light and power plant, including Diesel engine-generating units. A transmission line and distributing system will be built. Cost $400,000. Financing authorized.

Calif., San Francisco — Milwaukee Brewing Co., 490 Tenth Street, plans installation of electric power equipment in connection with expansion and improvement program for complete modernization. Entire project will cost about $200,000. Warren E. Murray, 908 Hayes Street, is engineer.

Ind., Goshen—City Council has plans maturing for extensions and improvements in municipal electric light and power plant, and city waterworks. Entire project will cost about $100,000, with equipment. Financing is being arranged. Bemis Co., 105 West Adams Street, Chicago, Ill., is consulting engineer.

Ind., Hope—Common Council plans installation of pumping machinery and auxiliary equipment for municipal water supply system. Entire project will cost about $60,000. Arrangements are being made for Federal loan.

Ind., Newcastle—City Council is considering expansion and improvement program at municipal electric light and power plant, reported to cost over $250,000, with equipment. Financing will be arranged in near future.

Kan., Chanute—Municipal Light Department, E. A. Pierce, superintendent, plans extensions and improvements in municipal electric light and power plant, including installation of new 2500 kw. turbo-generator unit and accessory equipment. Cost about $70,000.

Kan., Kansas City—Board of Public Utilities, C. A. Lowder, secretary, plans construction of three new booster pumping plants, with complete equipment, for municipal water system. Cost about $112,000. Financing is being arranged.

Ky., Louisville—Frankfort Distillery Co., Dixie Highway, plans construction of new boiler plant in connection with expansion and improvement program in plant. Electric power equipment, tanks, conveyors and other equipment will be installed for distillery service. Cost over $75,000. Carl J. Epping, Shelby Street and Broadway, Louisville, is architect.

Mass., Boston—State Department of Mental Diseases, State House, is completing plans for addition to power plant at Boston State Hospital, Dorchester, including improvements in present station. New equipment will be installed. Cost $422,000. Financing has been arranged in that amount. R. D. Kimball Co., 6 Beacon Street, is consulting engineer.

Mich., Detroit — Continental Malt Co., care of G. A. Mueller, 1346 Broadway, architect, recently organized, plans construction of one-story steam power house at proposed new malt plant at East Davison Street and Grand Trunk Railway. Entire project will cost over $125,000. Martin E. Galvin, Commonwealth Commercial State Bank Building, is interested in new company.

Mich., Dowagiac — City Council is considering construction of new municipal electric light and power plant, to cost approximately $200,000, with equipment. Financing will be arranged in near future.

Minn., Glenwood—At special election, citizens have approved bonds for $140,000 for a new municipal electric light and power plant. City Council will proceed with project at early date.

Minn., Shakopee — Shakopee Breweries, Inc., C. T. Weiland, president, plans construction of new one-story steam power house in connection with new local brewing plant. Entire project will cost about $85,000. Robert J. Torrens, Shubert Building, St. Paul, Minn., is engineer.

Mo., Cape Girardeau—City Council is considering construction of a municipal electric light and power plant. Surveys and estimates of cost, totaling $685,000, have been made by Burns & McDonnell Engineering Co., 107 West Linwood Boulevard, Kansas City, Mo., consulting engineer. Proposed to arrange financing at early date.

Mo., Concordia—At special election, citizens have authorized City Council to arrange bond issue of $70,000, fund to be used for a new municipal electric light and power plant. Proposed to begin work at early date. W. B. Rollins & Co., Railway Exchange Building, Kansas City, Mo., are consulting engineers.

Neb., Hastings — Common Council has surveys under way for extensions and improvements in municipal electric light and power plant, including installation of equipment. Cost about $25,700. Black & Veatch, Mutual Building, Kansas City, Mo., are consulting engineers.

Neb., Lincoln—Northern Gas & Pipe Line Co., Lincoln, Frank H. Brooks, president, plans early construction of new compressor plant for natural gas pipe line service. Cost over $200,000, with equipment.

N. J., Bordentown—City Council is planning new municipal electric light and power plant, estimated to cost $104,000. Project will be placed before citizens for approval at general November election. Charles B. Rodgers is chairman of survey committee for new plant.

N. Y., Brooklyn—Interboro Beverage Corporation, 165-207 Melrose Street, has plans under way for additions to steam power house on Melrose Street, near Central Avenue, including improvements in present structure and installation of new equipment. Cost about $125,000. Shampan & Shampan, 188 Montague Street, city, are architects.

Ohio, Cincinnati—Christian Moerlein Brewing Co., Inc., Provident Bank Building, plans construction of power house in connection with new brewery on 30-acre tract of land. Brewing plant will consist of several multi-story units, equipped for capacity of 500,000 barrels per annum. Entire project will cost close to $4,000,000. Richard Griesser & Son, 54 West Randolph Street, Chicago, Ill., are architects. Joseph H. Assel is president and treasurer.

Ohio, Youngstown—City Council is considering installation of a municipal power distribution system to cost close to $500,000. Project will be placed before voters at November general election for approval. City engineer will be in charge.

Ore., Bonneville—Bureau of Reclamation, Denver, Colo., will prepare plans and call for bids in near future for proposed new hydroelectric power plant on Columbia River, near Bonneville, for which Government has authorized initial appropriation of $20,000,000. It will comprise six generating units with power substations, switching stations, transmission lines and other structures. Ultimate development will cost $31,000,000.

Que., Noranda — Noranda Mines, Ltd., 2 King Street, Toronto, Ont., plans installation of electric power equipment, conveying and other mechanical equipment in connection with expansion program at concentrating and ore-handling plants at gold mining properties, Noranda. Entire project will cost about $400,000. Ernest Hibbert is company engineer.

R. I., North Kingston — Board of City Trustees plans installation of pumping machinery and accessory power equipment for new municipal waterworks. Entire project will cost $110,000. Financing has been arranged.

Tenn., Kingsport — Tennessee-Eastman Corporation will make additions to power plant at cellulose products mill, with installation of additional power equipment. Company has authorized expansion program at mill for doubling capacity, estimated to cost about $4,000,000. T. S. Wilcox is general manager.

Va., Danville—City Council is securing Federal loan of $2,500,000 for construction of new municipal hydroelectric generating plant on Dan River, Patrick County, including power dam, power station, substations, transmission and distributing lines. Proposed to ask bids and begin work at early date. E. C. Brantley, manager, Department of Public Utilities, in charge.

Va., Williamsburg — City Council plans installation of pumping machinery and auxiliary power equipment in connection with new municipal water supply and sanitary sewer system. Cost $223,650 with equipment. Financing is being arranged. A municipal incinerator plant is also projected.

Wis., Wonewoc—Hamburg Brewing Co., recently organized by C. E. Hamburg and W. Peters, both of Wonewoc, plans construction of power house, using steam-electric or Diesel engine-generating units, for new multi-story brewing plant on local site. Entire project will cost about $130,000. Urban F. Peacock, 719 North Thirty-second Street, Milwaukee, Wis., is architect.